Technical Handbook
1991

SOT-23
TRANSISTORS & DIODES
INCLUDING OTHER SURFACE MOUNT PRODUCTS

ZETEX

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SOT-23 TRANSISTORS & DIODES TECHNICAL HANDBOOK

This guide contains comprehensive information on all SOT-23 transistors and diodes, together with selected information of our SOT-223, SOT-89, E-line 'SM' and E-line 'M1' products available in the Zetex Discrete Semiconductor Range.

SOT-23 TRANSISTORS & DIODES

CONTENTS

SOT-23 TRANSISTORS & DIODES

GENERAL INFORMATION

SOT-23 is the internationally standardised semiconductor package for hybrid and surface mountable assembly of transistors and diodes. Designed specifically for use in thick and thin film hybrid circuits, these devices offer considerable advantages over other packages and chip and wire assembly techniques. With the progression of SMT (Surface Mount Technology), the new optimum profile SOT-23 design makes this package ideal for surface mounting on PCBs (Printed Circuit Boards).

The wide range of bipolar and MOSFET transistors, together with a large variety of SOT-23 diodes gives the circuit designer maximum flexibility in designing new circuits, and minimum redesign time in translating conventional printed circuit board layouts to surface mountable printed circuit boards.

This micro-miniature package provides the optimum cost/real estate solution to high volume hybrid and PCB manufacture, whether in commercial, industrial or military applications.

NEW PRODUCTS

The continual evolution of new products means that our range is being constantly updated. If your particular requirement is not covered herein, please do not hesitate to contact us for new product information.

Customer Specifications

Devices may be supplied against 'in-house' specifications to suit individual customer requirements for:

a). Non-standard Electrical or Environmental specifications.

b). Customer Procurement Specification.

Device pricing will be dependant on the basic type, additional work involved, test yield and the quantity required.

'R' Reverse Joggled Types

These are available as standard product on a variety of the transistor types in our range. 'R' joggle transistors are identified by a suffix R after the type number.

e.g. BCW33R

'R' Joggle devices are simply conventional SOT-23s with the emitter and base connections reversed.

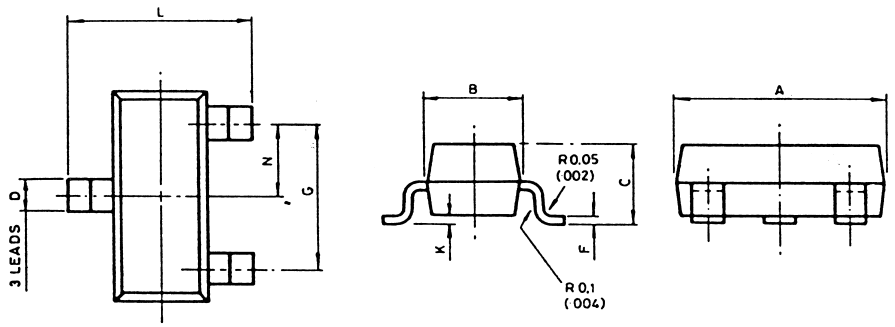
MAXIMUM THERMAL RATINGS

Junction Temperature	150°C
Operating and Storage Temperature	−55°C to +150°C

SOT-23 TRANSISTORS & DIODES

PACKAGE OUTLINE DETAILS

Dimensions are shown thus: mm



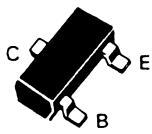
SOT-23

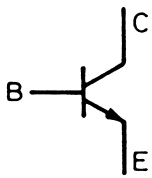
DIM	Millimetres		Inches	
	Min.	Max.	Min.	Max.
A	2.67	3.05	0.105	0.120
B	1.20	1.40	0.047	0.055
C	—	1.10	—	0.043
D	0.37	0.53	0.0145	0.021
F	0.085	0.15	0.0033	0.0059
G	NOM 1.9		NOM 0.075	
K	0.01	0.10	0.0004	0.004
L	2.10	2.5	0.0825	0.0985
N	NOM 0.95		NOM 0.037	

SOT-23 TRANSISTORS & DIODES

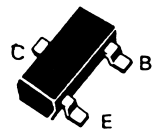
PIN CONNECTIONS

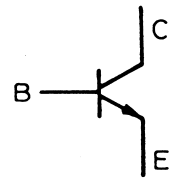
BIPOLAR TRANSISTORS





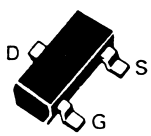
Conventional

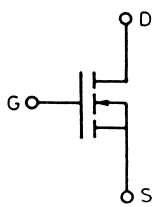




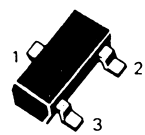
'R' Joggle

MOSFETS

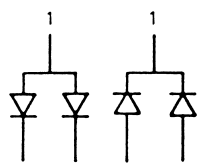


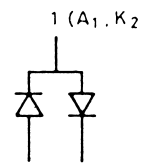


DIODES



SINGLE DIODE





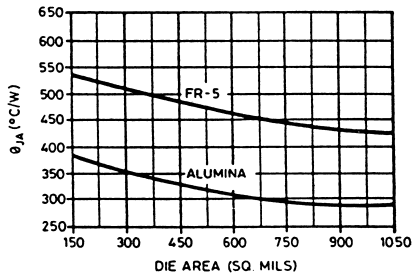
***Other pin-outs are available. Please refer to individual data sheets.**

SOT-23 TRANSISTORS & DIODES

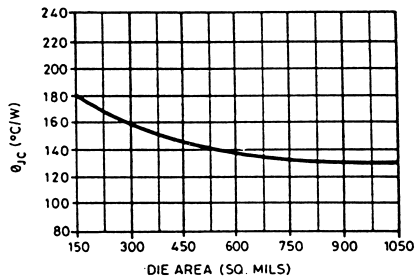
THERMAL DATA

The power dissipation is dependant on many factors that must be taken into consideration in the initial board design. The board material, the board surface, metal thickness, pad area and the proximity to other heat generating components all have a bearing on the device dissipation capability.

Thermal Resistance
θJA comparison



Thermal Resistance
θJC



Thermal Ratings and Power Dissipation

	FR-5	Alumina
θJA (°C/W)	430	290
θJC (°C/W)	130	130
θCA (°C/W)	300	160
PD (mW)	290	431

Typical Example: Die Size = 30 × 30 mils
FR5 = 1″ × 0.75″ × 0.062″
Alumina = 0.4″ × 0.3″ × 0.024″ (99.5% Alumina)
P_D = $T_{J(max.)}$ − TA/RθJA

Our new high performance SOT-23's are capable of offering power handling up to 500 mW when mounted on a ceramic substrate measuring 15 mm × 15 mm × 0.6 mm.

SOT-23 TRANSISTORS & DIODES

PRODUCT LIST AND DEVICE IDENTIFICATION

TRANSISTORS			TRANSISTORS		
Device Type	Standard Marking	Reverse Joggle Marking	Device Type	Standard Marking	Reverse Joggle Marking
BC846A	1A	–	BCW67B	DB	5W
BC846B	1B	–	BCW67C	DC	6W
BC847A	1E	–	BCW68F	DF	7T
BC847B	1F	–	BCW68G	DG	6T
BC847C	1G	–	BCW68H	DH	7N
BC848A	1J	–	BCW69	H1	H4
BC848B	1K	–	BCW70	H2	H5
BC848C	1L	–	BCW71	K1	K4
BC849B	2B	–	BCW72	K2	K5
BC849C	2C	–	BCW89	H3	H6
BC850B	2F	–	BCX17	T1	T4
BC850C	2G	–	BCX18	T2	T5
BC856A	3A	–	BCX19	U1	U4
BC856B	3B	–	BCX20	U2	U5
BC857A	3E	–	BCX41	EK	–
BC857B	3F	–	BCX70G	AG	AW
BC857C	3G	–	BCX70H	AH	9P
BC858A	3J	–	BCX70J	AJ	AX
BC858B	3K	–	BCX70K	AK	P9
BC858C	3L	–	BCX71G	BG	CG
BC859A	4A	–	BCX71H	BH	6P
BC859B	4B	–	BCX71J	BJ	J8
BC859C	4C	–	BCX71K	BK	CK
BC860A	4E	–	BFQ31	S2	S3
BC860B	4F	–	BFQ31A	S4	S5
BC860C	4G	–	BFS17	E1	–
BCV26	ZFD	–	BS170F	MV	–
BCV27	ZFF	–	BS250F	MX	–
BCV46	ZFE	–	BSS63	T3	T6
BCV47	ZFG	–	BSS64	U3	U6
BCV71	K7	K6	BSS65	L1	L5
BCV72	K8	K9	BSS66	M6	M8
BCW29	C1	C4	BSS67	M7	M9
BCW30	C2	C5	BSS69	L2	L6
BCW31	D1	D4	BSS70	L3	L7
BCW32	D2	D5	BSS79B	CE	–
BCW33	D3	D6	BSS79C	CF	–
BCW60A	AA	CR	BSS80B	CH	–
BCW60B	AB	DR	BSS80C	CJ	–
BCW60C	AC	AR	BSS82B	CL	–
BCW60D	AD	BR	BSS82C	CM	–
BCW61A	BA	CA	BSS84	SP	–
BCW61B	BB	CB	BSS123	SA	–
BCW61C	BC	CC	BSS138	SS	–
BCW61D	BD	CD	BSV52	B2	B4
BCW65A	EA	4V	FMMTA05	1H	NA
BCW65B	EB	5V	FMMTA06	1G	MA
BCW65C	EC	6V	FMMTA12	3W	–
BCW66F	EF	7P	FMMTA13	1M	–
BCW66G	EG	5T	FMMTA14	1N	–
BCW66H	EH	7M	FMMTA20	1C	3C
BCW67A	DA	4W	FMMTA42	3E	7E

SOT-23 TRANSISTORS & DIODES

PRODUCT LIST AND DEVICE IDENTIFICATION

TRANSISTORS			TRANSISTORS		
Device Type	Standard Marking	Reverse Joggle Marking	Device Type	Standard Marking	Reverse Joggle Marking
FMMTA43	1E	5E	FMMT2369A	P5	9A
FMMTA55	2H	NB	FMMT2484	4G	—
FMMTA56	2G	MB	FMMT2907	2B	4P
FMMTA63	Z2U	—	FMMT2907A	2F	5P
FMMTA64	Z2V	—	FMMT3903	1W	—
FMMTA70	2C	—	FMMT3904	1A	—
FMMTA92	4E	8E	FMMT3905	2W	—
FMMTA93	2E	6E	FMMT3906	2A	—
FMMT38A	4J	—	FMMT4123	ZB	—
FMMT38B	5J	—	FMMT4124	ZC	—
FMMT38C	7J	—	FMMT4125	ZD	—
FMMT415	415	—	FMMT4126	ZE	—
FMMT449	449	—	FMMT4400	1K	—
FMMT451	451	—	FMMT4401	1L	—
FMMT455	455	—	FMMT4402	2K	—
FMMT489	489	—	FMMT4403	2L	—
FMMT491	491	—	FMMT5087	2M	3M
FMMT491A	41A	—	FMMT5088	1Q	—
FMMT493	493	—	FMMT5089	1R	—
FMMT494	494	—	FMMT5209	2Q	—
FMMT495	495	—	FMMT5210	2R	—
FMMT497	497	—	FMMT5400	1L	—
FMMT549	549	—	FMMT5401	2L	—
FMMT549A	59A	—	FMMT5550	1F	—
FMMT551	551	—	FMMT5551	G1	—
FMMT555	555	—	HT2	2T	—
FMMT576	576	—	HT3	3T	—
FMMT589	589	—	VN10LF	MY	—
FMMT591	591	—	ZVN3306F	MC	—
FMMT591A	91A	—	ZVN3310F	MF	—
FMMT593	593	—	ZVN3320F	MU	—
FMMT596	596	—	ZVN4106F	MZ	—
FMMT597	597	—	ZVP1320F	MT	—
FMMT918	3B	—	ZVP3306F	ML	—
FMMT2222	1B	2P	ZVP3310F	MR	—
FMMT2222A	1P	3P	2N7002	702	—
FMMT2369	1J	9R			

SOT-23 TRANSISTORS & DIODES

PRODUCT LIST AND DEVICE IDENTIFICATION

DIODES		DIODES	
Device Type	Standard Marking	Device Type	Standard Marking
BAL74	JC	FMMD2838	A6
BAL99	E2	FMMD6050	5A
BAR74	JB	FMMD6100	5B
BAR99	E3	FMMD7000	5C
BAS16	A3	FMMV105G	4E
BAS19	A8	FMMV109	4A
BAS20	A81	FMMV2101	6R
BAS21	A82	FMMV2102	6F
BAS70-04	2Z	FMMV2103	6G
BAS70-05	2Z5	FMMV2104	6H
BAS70-06	1Z	FMMV2105	6J
BAV70	A4	FMMV2106	6K
BAV74	JA	FMMV2107	6L
BAV99	A7	FMMV2108	6M
BAW56	A1	FMMV2109	6N
BBY31	S1	FMMV3102	4C
BBY40	S2	FMMZ5232	8G
BZX84C2V7	W4	FMMZ5233	8H
BZX84C3V0	W5	FMMZ5234	8J
BZX84C3V3	W6	FMMZ5235	8K
BZX84C3V6	W7	FMMZ5236	8L
BZX84C3V9	W8	FMMZ5237	8M
BZX84C4V3	W9	FMMZ5238	8N
BZX84C4V7	Z1	FMMZ5239	8P
BZX84C5V1	Z2	FMMZ5240	8Q
BZX84C5V6	Z3	FMMZ5241	8R
BZX84C6V2	Z4	FMMZ5242	8S
BZX84C6V8	Z5	FMMZ5243	8T
BZX84C7V5	Z6	FMMZ5244	8U
BZX84C8V2	Z7	FMMZ5245	8V
BZX84C9V1	Z8	FMMZ5246	8W
BZX84C10	Z9	FMMZ5247	8X
BZX84C11	Y1	FMMZ5248	8Y
BZX84C12	Y2	FMMZ5249	8Z
BZX84C13	Y3	FMMZ5250	81A
BZX84C15	Y4	FMMZ5251	81B
BZX84C16	Y5	FMMZ5252	81C
BZX84C18	Y6	FMMZ5253	81D
BZX84C20	Y7	FMMZ5254	81E
BZX84C22	Y8	FMMZ5255	81F
BZX84C24	Y9	FMMZ5256	81G
BZX84C27	X1	FMMZ5257	81H
BZX84C30	X2	HD2A	5D
BZX84C33	X3	HD3A	4D
BZX84C36	X4	HD4A	7D
BZX84C39	X5	ZC830	J1
BZX84C43	X6	ZC830A	J1
BZX84C47	X7	ZC830B	J1
FMMD914	5D	ZC831	J3
FMMD2835	A9	ZC831A	J3
FMMD2836	A2	ZC831B	J3
FMMD2837	A5	ZC832	J4

SOT-23 TRANSISTORS & DIODES

PRODUCT LIST AND DEVICE IDENTIFICATION

DIODES		DIODES	
Device Type	Standard Marking	Device Type	Standard Marking
ZC832A	J4	ZC835A	J6
ZC832B	J4	ZC835B	J6
ZC833	J2	ZC836	J7
ZC833A	J2	ZC836A	J7
ZC833B	J2	ZC836B	J7
ZC834	J5	ZC2800E	E6
ZC834A	J5	ZC2810E	E7
ZC834B	J5	ZC2811E	E8
ZC835	J6	ZC5800E	E9

SOT-23 TRANSISTORS & DIODES

APPROVED PRODUCTS

Device Type	BS/CECC Number	Approval Status	Device Type	BS/CECC Number	Approval Status
DIODES					
BAL74	50001-063	A	BSS63	PTT-022	A
BAR74	50001-064	A	BSS64 (R)	PTT-027	A
BAS16	PTD-008	A	BSS66-67	50004-156	A
BAS19	PTD-007	A	BSS69-70	50004-157	A
BAS20	PTD-007	A	BSV52	50004-158	A
BAS21	PTD-007	A	BSV52 (R)	PTT-007	A
BAV70	50001-065	A	FMMT2222/A	50004-159	A
BAV70	PTD-004	A	FMMT2222/A	PTT-006	A
BAV74	50001-066	A	FMMT2369/A	50004-160	A
BAV74	PTD-005	A	FMMT2907/A	PTT-029	A
BAV99	50001-067	A	FMMT3903/4	50004-161	A
BAV99	PTD-001	A	FMMT3905/6	50004-162	A
BAW56	50001-068	A	FMMT3905/6	PTT-020	A
BAW56	PTD-006	A	FMMTA05/6	50002-240	A
BZX84 Series	50005-022	A	FMMTA05/6	PTT-008	A
BZX84 Series	PTD-003	A	FMMTA12/A13/A14	50002-241	A
FMMD914	50001-069	A	FMMTA20	50002-242	A
FMMD914	PTD-002	A	FMMTA42/43	50002-243	A
HD2A	50001-070	A	FMMTA42/43	PTT-021	A
HD3A	50001-071	A	FMMTA55/56	50002-244	A
HD3A	PTD-009	A	FMMTA92/93	50002-245	A
HD4A	50001-072	A	FMMTA92/93	PTT-002	A
			HT2	50002-246	A
TRANSISTORS			HT2	PTT-001	A
			HT3	50002-247	A
BCV71-72	50002-230	A	HT3	PTT-024	A
BCV71-72 (R)	PTT-026				
BCW29-30	50002-229	A			
BCW31-33	50002-230	A			
BCW31-33 (R)	PTT-026	A			
BCW60 Series	50002-231	A			
BCW61 Series	50002-232	A			
BCW61 Series(R)	PTT-028	A			
BCW65-66	50002-233	A			
BCW67-68	50002-234	A			
BCW67-68 (R)	PTT-019	A			
BCW69-70	50002-229	A			
BCW69-70 (R)	PTT-009	A			
BCW71-72	50002-230	A			
BCW89	50002-229	A			
BCW89 (R)	PTT-030	A			
BCX17-18	50002-235	A			
BCX19-20	50002-236	A			
BCX70 Series	50002-237	A			
BCX71 Series	50002-238	A			
BFQ31/31A	50002-239	A			

PTD and PTT references are Zetex internal specifications designed to meet the long life requirements (D3007).

SOT-23 TRANSISTORS & DIODES

CONVERSION LIST (Conventional to Surface Mount)

Conventional Type	SOT-23 Equivalent/ Nearest Equivalent	Conventional Type	SOT-23 Equivalent/ Nearest Equivalent	Conventional Type	SOT-23 Equivalent/ Nearest Equivalent
BAV19	BAS19	BC178B	BCW61B/C	BC213A	BC857A
BAV20	BAS20		BCW30		BCW61A
BAV21	BAS21		BC858B		BCW29
BAW62	BAS16	BC178C	BCW61D	BC213B	BC857B
	HD3A		BC858C		BCW61C
	BAV70	BC179	BC859		BCW30
	BAV99		FMMT5087	BC213C	BC857C
	BAW56	BC179B	BC859B		BCW61D
	HD2A		FMMT5087		—
	HD4A	BC179C	BC859C	BC214	BC860
BB405	ZC831A		—		FMMT5087
BB809	ZC833A	BC182	BCV71/72	BC214B	BC860B
BC107	BC847		BC846		FMMT5087
	BCW71/72		BCX70	BC214C	BC860C
	BCX70	BC182A	BCV71		—
BC107A	BC847A		BC846A	BC237	BC847
	BCW71		BCX70G		BCX70
	BCX70G	BC182B	BCV72		BCW71/72
BC107B	BC847B		BC846B	BC237A	BC847A
	BCW72		BCX70J		BCX70G
	BCX70H/J	BC183	BC847		BCW71
BC108	BC848		BCW60	BC237B	BC847B
	BCW31-33		BCW31/32/33		BCX70H/J
	BCW60	BC183A	BC847A		BCW72
BC108A	BC848A		BCW60A/B	BC238	BC848
	BCW31		BCW31		BCW60
	BCW60A	BC183B	BC847B		BCW31/32/33
BC108B	BC848B		BCW60C	BC238A	BC848A
	BCW32		BCW32		BCW60A
	BCW60B/C	BC183C	BC847C		BCW31
BC108C	BC848C		BCW60D	BC238B	BC848B
	BCW33		BCW33		BCW60B/C
	BCW60D	BC184	BC850		BCW32
BC109	BC849		FMMT5210	BC238C	BC848C
	FMMT5209/10	BC184B	BC850B		BCW60D
BC109B	BC849B		FMMT5210		BCW33
	FMMT5209/10	BC184C	BC850C	BC239	BC849
BC109C	BC849C		FMMT5089		FMMT5209/10
	FMMT5088/89	BC200/01	BC859B		FMMT5088/89
BC177	BCX71	BC200/02	BC859B/C	BC239B	BC849B
	BCW69/70	BC200/03	BC859C		FMMT5209/10
	BC857	BC212	BCW89		—
BC177A	BCX71G		BC856	BC239C	BC849C
	BCW69		BCX71		FMMT5088/89
	BC857A	BC212A	BCW89		—
BC177B	BCX71H/J		BC856A	BC307	BC857
	BCW70		BCX71G		BCX71
	BC858B		BCW69		BCW69/70
BC178	BCW61	BC212B	BCX71J	BC307A	BC857A
	BCW29/30		BC856B		BCX7G
	BC858		BCW70		BCW69
BC178A	BCW61A	BC213	BC857	BC307B	BC857B
	BCW29		BCW61		BCX71H/J
	BC858A		BCW29/30		BCW70

SOT-23 TRANSISTORS & DIODES

CONVERSION LIST (Conventional to Surface Mount)

Conventional Type	SOT-23 Equivalent/ Nearest Equivalent
BC308	BC858 BCW61 BCW29/30
BC308A	BC858A BCW61A BCW29
BC308B	BC858B BCW61B/C BCW30
BC308C	BC858C BCW61D —
BC309	BC859 FMMT5087 —
BC309B	BC859B FMMT5087 —
BC309C	BC859C — —
BC327	BCX17
BC327A	BCW68F
BC327B	BCW68G
BC327C	BCW68H
BC328	BCX18
BC328A	BCW67A
BC328B	BCW67B
BC328C	BCW67C
BC337	BCX19
BC337A	BCW66F
BC337B	BCW66G
BC337C	BCW66H
BC338	BCX20
BC338A	BCW65A
BC338B	BCW65B
BC338C	BCW65C
BC413	BC849 FMMT5209/10 FMMT5088/89
BC413B	BC849B FMMT5209/10 —
BC413C	BC849C FMMT5089 —
BC414	BC850 FMMT5209/10 FMMT5088/89
BC414B	BC850B FMMT5210 —
BC414C	BC850C FMMT5089 —
BC415	BC859 FMMT5087 —
BC415B	BC859B FMMT5087 —
BC415C	BC859C — —
BC416	BC860 FMMT5087 —
BC416B	BC860B FMMT5087 —
BC416C	BC860C — —
BC546	BC846 BCV71/72
BC546A	BC846A BCV71
BC546B	BC846B BCV72
BC547	BC847 BCW71/72 BCX70
BC547A	BC847A BCW71 BCX70G
BC547B	BC847B BCW72 BCX70H/J
BC547C	BC847C BCX70K
BC548	BC848 BCW31/32/33 BCW60
BC548A	BC848A BCW31 BCW60A
BC548B	BC848B BCW32 BCW60B/C
BC548C	BC848C BCW33 BCW60D
BC549	BC849 FMMT5088/89 FMMT5209/10
BC549B	BC849B FMMT5209/10
BC549C	BC849C FMMT5089
BC550	BC850 FMMT5209/10
BC550B	BC850B FMMT5209/10
BC550C	BC850C —
BC556	BC856 BCW89
BC556A	BC856A BCW89
BC556B	BC856B —
BC557	BC857 BCW69/70 BCX71
BC557A	BC857A BCW69 BCX71G
BC557B	BC857B BCW70 BCX71H/J
BC557C	BC857C BCX71K
BC558	BC858 BCW61 BCW29/30
BC558A	BC858A BCW61A BCW29
BC558B	BC858B BCW61B/C BCW30
BC558C	BC858C BCW61D
BC559	BC859 FMMT5087
BC559A	BC859A —
BC559B	BC859B FMMT5087
BC559C	BC859C —
BC560	BC860 FMMT5087
BC560A	BC860A —
BC560B	BC860B FMMT5087
BC560C	BC860C —

SOT-23 TRANSISTORS & DIODES

CONVERSION LIST (Conventional to Surface Mount)

Conventional Type	SOT-23 Equivalent/ Nearest Equivalent	Conventional Type	SOT-23 Equivalent/ Nearest Equivalent	Conventional Type	SOT-23 Equivalent/ Nearest Equivalent
BCX38A	FMMT38A	MPS2222	FMMT2222	ZTX108	BC848
BCX38B	FMMT38B	MPS2222A	FMMT2222A		BCW31-33
BCX38C	FMMT38C	MPS2369	FMMT2369		BCW60
BCX58	BCW60	MPS2369A	FMMT2369A	ZTX108A	BC848A
BCY58A/VII	BCW60A	MPS2907	FMMT2907		BCW31
BCY58B/VIII	BCW60B	MPS2907A	FMMT2907A		BCW60A
BCY58C/IX	BCW60C	MPSA05	FMMTA05	ZTX108B	BC848B
BCY59D/X	BCW60D	MPSA06	FMMTA06		BCW32
BCY59	BCX70	MPSA12	FMMTA12		BCW60B/C
BCY59A/VII	BCX70G	MPSA13	FMMTA13	ZTX108C	BC848C
BCY59B/VIII	BCX70H	MPSA14	FMMTA14		BCW33
BCY59C/IX	BCX70J	MPSA20	FMMTA20		BCW60D
BCX59D/X	BCX70K	MPSA42	FMMTA42	ZTX109	BC849
BCY65E	BCV71/72	MPSA43	FMMTA43		FMMT5209/10
	BC846	MPSA55	FMMTA55	ZTX109B	BC849B
BCY65EA	BCV71	MPSA56	FMMTA56		FMMT5209/10
	BC846A	MPSA70	FMMTA70	ZTX109C	BC849C
BCY65EB	BCV72	MPSA92	FMMTA92		FMMT5088/89
	BC846B	MPSA93	FMMTA93	ZTX114	FMMT5210
BCY65EC	BC846C	ZC820	ZC830		FMMT5088/89
	—	ZC820A	ZC830A	ZTX212	BCW89
BCY70	FMMT3906	ZC820B	ZC830B		BC856
	BSS70	ZC821	ZC831		BCX71
BCY71	FMMT3906	ZC821A	ZC831A	ZTX212A	BCW89
	BSS70	ZC821B	ZC831B		BC856A
BCY72	FMMT3906	ZC822	ZC832		BCX71G
	FMMT4126	ZC822A	ZC832A	ZTX2121B	BCX71J
BCY77	BCW89	ZC822B	ZC832B		BC856B
	BC856	ZC823	ZC833		BCW70
BCY77A	BCW89	ZC823A	ZC833A	ZTX213	BC857
	BC856A	ZC823B	ZC833B		BCW61
BCY77B	BC856B	ZC824	ZC834		BCW29/30
	—	ZC824A	ZC834A	ZTX213A	BC857A
BCY77C	BC856C	ZC824B	ZC834B		BCW61A
	—	ZC825	ZC835		BCW29
BCY78	BCW61	ZC825A	ZC835A	ZTX213B	BC857B
BCY78A/VII	BCW61A	ZC825B	ZC835B		BCW61C
BCY78B/VIII	BCW61B	ZC826	ZC836		BCW30
BCY78C/IX	BCE61C	ZC826A	ZC836A	ZTX213C	BC857C
BCY78D/X	BCW61D	ZC826B	ZC836B		BCW61D
BCY79	BCX71	ZC2800	ZC2800E		—
BCY79A/VII	BCX71G	ZC2810	ZC2810E	ZTX214	BC860
BCY79B/VIII	BCX71H	ZC2811	ZC2811E		FMMT5087
BCY79C/IX	BCX71J	ZC5800	ZC5800E	ZTX214B	BC860B
BFS59	BCW65A	ZTX107	BC847		FMMT5087
BFS60	BCW66F		BCW71/72	ZTX214C	BC860C
BFS61	FMMTA05		BCX70		—
BFS96	BCW67A	ZTX107A	BC847A	ZTX223	BCW65B/C
BFS97	BCW68F		BCW71	ZTX223A	BCW65B
BFS98	FMMTA55/56		BCX70G	ZTX223B	BCW65C
BF420	FMMTA42	ZTX107B	BC847B	ZTX237	BC847
BF421	FMMTA92		BCW72		BCX70
BF422	FMMTA43		BCX70H/J		BCW71/72
BF423	FMMTA93				

SOT-23 TRANSISTORS & DIODES

CONVERSION LIST (Conventional to Surface Mount)

Conventional Type	SOT-23 Equivalent/ Nearest Equivalent	Conventional Type	SOT-23 Equivalent/ Nearest Equivalent	Conventional Type	SOT-23 Equivalent/ Nearest Equivalent
ZTX237A	BC847A	ZTX382B	BCX70J	ZTX556	FMMT596
	BCX70G		BC860B	ZTX557	FMMT597
	BCW71	ZTX382C	BC860C	ZTX576	FMMT576
ZTX237B	BC847B		—	IN914	FMMD914
	BCX70H/J	ZTX383	BCW60	IN4148	BAS16
	BCW72		BC859		HD3A
ZTX238	BC848	ZTX383B	BC859B		BAV70
	BCW60		BCW60C		HD2A
	BCW31/32/33	ZTX383C	BC859C		BAV99
ZTX238A	BC848A		—		BAW56
	BCW60A	ZTX384	BC859		HD4A
	BCW31		FMMT5210	2N918	FMMT918
ZTX238B	BC848B		FMMT5088/89	2N2218	BSS79B
	BCW60B/C	ZTX384B	BC859B	2N2219	FMMT2222
	BCW32		FMMT5210	2N2221	BSS79B
ZTX238C	BC848C	ZTX384C	BC859C	2N2222	FMMT2222
	BCW60D		FMMT5089	2N2218A	BSS79B
	BCW33	ZTX415	FMMT415	2N2219A	FMMT2222A
ZTX239	BC849	ZTX449	FMMT449		BSS79C
	FMMT5009/10		FMMT489	2N2221A	BSS79B
	FMMT5088/89	ZTX450	FMMT491	2N2222A	FMMT2222A
ZTX239B	BC849B	ZTX451	FMMT451		BSS79C
	FMMT5209/10	ZTX452	FMMT493	2N2368	BSV52
ZTX239C	BC849C	ZTX453	FMMT493		FMMT2369
	FMMT5088/89	ZTX454	FMMT494	2N2369	FMMT2369
ZTX300	BCW60A/B	ZTX455	FMMT495	2N2369A	FMMT2369A
ZTX301	BCW60A/B	ZTX500	BCW61A/B	2N2484	FMMT2484
ZTX302	BCX70H	ZTX501	BCW61A/B	2N2894	BSS65
ZTX303	BCX70G/H	ZTX502	BCX71H	2N2904	BSS80B
ZTX304	BCV71	ZTX503	BCX71G/H	2N2905	FMMT2907
ZTX310	BSV52	ZTX504	BCW89		BSS80C
ZTX311	FMMT2369A	ZTX510	BSS65	2N2906	BSS80B
ZTX312	FMMT2369	ZTX530	BCW61D	2N2907	FMMT2907
ZTX313	FMMT2369A	ZTX531	BCX71G		BSS80C
ZTX314	FMMT2369A	ZTX537	BCX17	2N2904A	BSS82B
ZTX320	FMMT918	ZTX537A	BCW68F	2N2905A	FMMT2907A
ZTX321	FMMT918	ZTX537B	BCW68G		BSS82C
ZTX322	BFQ31	ZTX537C	BCW68H	2N2906A	BSS82B
ZTX323	BFQ31A	ZTX538	BCX18	2N2907A	FMMT2907A
ZTX330	FMMT5209	ZTX538A	BCW67A		BSS82C
	BCW60D	ZTX538B	BCW67B	2N3903	FMMT3903
ZTX331	BCX70G	ZTX538C	BCW67C	2N3904	FMMT3904
ZTX337	BCX19	ZTX541	HT3	2N3905	FMMT3905
ZTX337A	BCW66F	ZTX542	BSS63	2N3906	FMMT3906
ZTX337B	BCW66G	ZTX549	FMMT549	2N4123	FMMT4123
ZTX337C	BCW66H		FMMT589	2N4124	FMMT4124
ZTX338	BCX20	ZTX549A	FMMT589	2N4125	FMMT4125
ZTX338A	BCW65A	ZTX550	FMMT591	2N4126	FMMT4126
ZTX338B	BCW65B	ZTX551	FMMT591	2N4400	FMMT4400
ZTX338C	BCW65C		FMMT551	2N4401	FMMT4401
ZTX341	HT2	ZTX552	FMMT593	2N4402	FMMT4402
ZTX342	BSS64	ZTX553	FMMT593	2N4403	FMMT4403
ZTX382	BCX70	ZTX554	FMMT595	2N5087	FMMT5087
	BC860	ZTX555	FMMT555		

SOT-23 TRANSISTORS & DIODES

GENERAL PURPOSE TRANSISTORS (NPN)

Type	V_{CBO} Volts	V_{CEO} Volts	I_C mA	P_{tot} mW	h_{FE} min./max.	at I_C/V_{CE} mA/volts	$V_{CE(sat)}$ max. at I_C/I_B Volts	mA	f_T typ. MHz
BC846A	80	65	100	330	110/220	2/5	0.25	10/0.5	300
BC846B	80	65	100	330	200/450	2/5	0.25	10/0.5	300
BCV71	80	60	100	330	100/220	2/5	0.25	10/0.5	300
BCV72	80	60	100	330	200/450	2/5	0.25	10/0.5	300
FMMT2484	60	60	50	330	100/500	0.01/5	0.35	1/0.1	200
FMMT3903	60	40	200	330	50/150	10/1	0.2	10/1	250
FMMT3904	60	40	200	330	100/300	10/1	0.2	10/1	300
FMMT5209	50	50	50	330	100/300	0.1/5	0.7	10/1	30 min
FMMT5210	50	50	50	330	200/600	0.1/5	0.7	10/1	30 min
BC850B	50	45	100	330	200/450	2/5	0.25	10/0.5	300
BC850C	50	45	100	330	420/800	2/5	0.25	10/0.5	300
BC847A	50	45	100	330	110/220	2/5	0.25	10/0.5	300
BC847B	50	45	100	330	200/450	2/5	0.25	10/0.5	300
BC847C	50	45	100	330	420/800	2/5	0.25	10/0.5	300
BCW71	50	45	100	330	110/220	2/5	0.25	10/0.5	300
BCW72	50	45	100	330	200/450	2/5	0.25	10/0.5	300
BCX70G	45	45	200	330	120/220	2/5	0.35	10/0.25	250
BCX70H	45	45	200	330	180/310	2/5	0.35	10/0.25	250
BCX70J	45	45	200	330	250/460	2/5	0.35	10/0.25	250
BCX70K	45	45	200	330	380/630	2/5	0.35	10/0.25	250
BCW60A	32	32	200	330	120/220	2/5	0.35	10/0.25	250
BCW60B	32	32	200	330	180/310	2/5	0.35	10/0.25	250
BCW60C	32	32	200	330	250/460	2/5	0.35	10/0.25	250
BCW60D	32	32	200	330	380/630	2/5	0.35	10/0.25	250
FMMT4123	40	30	200	330	50/150	2/1	0.3	50/5	250
FMMT5088	35	30	50	330	300/900	0.1/5	0.5	10/1	50 min
FMMT5089	30	25	50	330	400/1200	0.1/5	0.5	10/1	50 min
BC848A	30	30	100	330	110/220	2/5	0.25	10/0.5	300
BC848B	30	30	100	330	200/450	2/5	0.25	10/0.5	300
BC848C	30	30	100	330	420/800	2/5	0.25	10/0.5	300
BC849B	30	30	100	330	200/450	2/5	0.25	10/0.5	300
BC849C	30	30	100	330	420/800	2/5	0.25	10/0.5	300
FMMT4124	30	25	200	330	120/360	2/1	0.3	50/5	300
BCW31	30	20	100	330	110/220	2/5	0.25	10/0.5	300
BCW32	30	20	100	330	200/450	2/5	0.25	10/0.5	300
BCW33	30	20	100	330	420/800	2/5	0.25	10/0.5	300
FMMTA20	40	40	100	330	40/400	5/10	0.25	10/1	125

SOT-23 TRANSISTORS & DIODES

GENERAL PURPOSE TRANSISTORS (PNP)

Type	V_{CBO} Volts	V_{CEO} Volts	I_C mA	P_{tot} mW	h_{FE} min./max.	h_{FE} at I_C/V_{CE} mA/volts	$V_{CE(sat)}$ max. at I_C/I_B Volts	$V_{CE(sat)}$ max. at I_C/I_B mA	f_T typ. MHz
BC856A	80	65	100	330	110/220	2/5	0.3	10/0.5	150
BC856B	80	65	100	330	200/450	2/5	0.3	10/0.5	150
BCW89	80	60	100	330	120/260	2/5	0.3	10/0.5	150
FMMT3905	60	40	200	330	50/150	10/1	0.2	10/1.0	250
FMMT3906	60	40	200	330	100/300	10/1	0.2	10/1.0	300
FMMTA70	50	50	100	330	40/400	5/10	0.3	10/1.0	150
FMMT5087	50	50	100	330	250/800	0.1/5	0.3	10/1.0	100
BCW69	50	45	100	330	120/260	2/5	0.3	10/0.5	150
BCW70	50	45	100	330	215/500	2/5	0.3	10/0.5	150
BC857A	50	45	100	330	110/220	2/5	0.3	10/0.5	150
BC857B	50	45	100	330	200/450	2/5	0.3	10/0.5	150
BC857C	50	45	100	330	420/800	2/5	0.3	10/0.5	150
BC860A	50	45	100	330	110/220	2/5	0.25	10/0.5	300
BC860B	50	45	100	330	200/450	2/5	0.25	10/0.5	300
BC860C	50	45	100	330	420/800	2/5	0.25	10/0.5	300
BCX71G	45	45	200	330	120/220	2/5	0.25	10/0.25	180
BCX71H	45	45	200	330	180/310	2/5	0.25	10/0.25	180
BCX71J	45	45	200	330	250/460	2/5	0.25	10/0.25	180
BCX71K	45	45	200	330	380/630	2/5	0.25	10/0.25	180
BCW61A	32	32	200	330	120/220	2/5	0.25	10/0.25	180
BCW61B	32	32	200	330	180/310	2/5	0.25	10/0.25	180
BCW61C	32	32	200	330	250/460	2/5	0.25	10/0.25	180
BCW61D	32	32	200	330	380/630	2/5	0.25	10/0.25	180
FMMT4125	30	30	200	330	50/150	2/1	0.4	50/5	200
BC858A	30	30	100	330	110/220	2/5	0.3	10/0.5	150
BC858B	30	30	100	330	200/450	2/5	0.3	10/0.5	150
BC858C	30	30	100	330	420/800	2/5	0.3	10/0.5	150
BC859A	30	30	100	330	110/220	2/5	0.25	10/0.5	300
BC859B	30	30	100	330	200/450	2/5	0.25	10/0.5	300
BC859C	30	30	100	330	420/800	2/5	0.25	10/0.5	300
FMMT4126	25	25	200	330	120/360	2/1	0.4	50/5	250
BCW29	30	20	100	330	120/260	2/5	0.3	10/0.5	150
BCW30	30	20	100	330	215/500	2/5	0.3	10/0.5	150

SOT-23 TRANSISTORS & DIODES

LOW NOISE TRANSISTORS

Type	V_{CBO} Volts	V_{CEO} Volts	I_C mA	P_{tot} mW	h_{FE} min./max.	h_{FE} at I_C/V_{CE} mA/volts	$V_{CE(sat)}$ max. at I_C/I_B Volts	$V_{CE(sat)}$ max. at I_C/I_B mA	f_T typ. MHz
NPN									
FMMT5209	50	50	50	330	100/300	0.1/5	3	0.2/5	30
FMMT5210	50	50	50	330	200/600	0.1/5	2	0.2/5	30
BC850B	50	45	100	330	200/450	2/5	3	0.2/5	300
BC850C	50	45	100	330	420/800	2/5	3	0.2/5	300
FMMT5088	35	30	50	330	300/900	0.1/5	3	0.1/5	50
BC849B	30	30	100	330	200/450	2/5	4	0.2/5	300
BC849C	30	30	100	330	420/800	2/5	4	0.2/5	300
FMMT5089	30	25	50	330	400/1200	0.1/5	2	0.1/5	50
PNP									
BC860A	50	45	100	330	125/250	2/5	3	0.2/5	300
BC860B	50	45	100	330	220/475	2/5	3	0.2/5	300
BC860C	50	45	100	330	420/800	2/5	3	0.2/5	300
BC859A	30	30	100	330	125/250	2/5	4	0.2/5	300
BC859B	30	30	100	330	270/475	2/5	4	0.2/5	300
BC859C	30	30	100	330	420/800	2/5	4	0.2/5	300

AVALANCHE TRANSISTOR (NPN)

Type	V_{CBO} V	V_{CEO} V	h_{FE} at Min	h_{FE} at I_C mA	Peak† Collector Current I_{CM} A	P_{tot} at $T_{amb}=25°C$ mW	I_{SB}* at A	I_{SB}* at V_C V	f_T at MHz	f_T at I_C mA
FMMT415	260	100	25	10	60	680	25	250	40	10

*Current in second breakdown.
†Maximum pulse width 20nsec.

Specifically designed to operate in the avalanche mode. Suitable for pulsing laser diodes and other applications requiring very fast edges.

SWITCHING TRANSISTORS (PNP)

Type	V_{CBO} Volts	V_{CEO} Volts	I_C mA	P_{tot} mW	h_{FE} min./max.	h_{FE} at I_C/V_{CE} mA/volts	$V_{CE(sat)}$ max. at I_C/I_B Volts	$V_{CE(sat)}$ max. at I_C/I_B mA	f_T typ. MHz
BSS82B	60	60	800	330	40/120	150/10	0.4	150/15	200
BSS82C	60	60	800	330	100/300	150/10	0.4	150/15	200
FMMT2907A	60	60	600	330	100/300	150/10	0.4	150/15	200
FMMT2907	60	40	600	330	100/300	150/10	0.4	150/15	200
BSS80B	60	40	800	330	40/120	150/10	0.4	150/15	200
BSS80C	60	40	800	330	100/300	150/10	0.4	150/15	200
FMMT3905	60	40	200	330	50/150	10/1	0.2	10/1.0	250
FMMT3906	60	40	200	330	100/300	10/1	0.2	10/1.0	300
FMMT4402	40	40	600	330	50/150	150/1	0.4	150/15	200
FMMT4403	40	40	600	330	100/300	150/1	0.4	150/15	200
BSS69	40	40	100	330	50/150	10/1	0.25	10/1	200
BSS70	40	40	100	330	100/300	10/1	0.25	10/1	250
FMMT4125	30	30	200	330	50/150	2/1	0.4	50/5	200
FMMT4126	25	25	200	330	120/360	2/1	0.4	50/5	250
BSS65	12	12	100	330	40/150	30/0.5	0.15	10/1	400

VHF TRANSISTORS (NPN)

Type	V_{CBO} Volts	V_{CEO} Volts	I_C mA	P_{tot} mW	h_{FE} min./max.	h_{FE} at I_C/V_{CE} mA/volts	N Typ. at f dB	N Typ. at f MHz	f_T typ. MHz
FMMT918	30	15	100	330	20/–	3/1	6.0	60	600
BFQ31A	30	15	100	330	100/–	3/1	6.0	60	600
BFQ31	30	15	100	330	20/–	3/1	6.0	60	600
BFS17	30	15	25	330	25/150	2/1	4.5	500	1300

SOT-23 TRANSISTORS & DIODES

HIGH VOLTAGE TRANSISTORS

Type	V_{CBO} Volts	V_{CEO} Volts	I_C mA	P_{tot} mW	h_{FE} min./max.	h_{FE} at I_C/V_{CE} mA/volts	$V_{CE(sat)}$ max. at I_C/I_B Volts	$V_{CE(sat)}$ max. at I_C/I_B mA	f_T typ. MHz
NPN									
FMMTA42	300	300	200	330	40/–	30/10	0.5	20/2.0	50
FMMTA43	200	200	200	330	50/200	10/10	0.4	20/2.0	50
FMMT5551	180	160	600	330	80/250	10/5	0.4	50/5	200
FMMT5550	180	140	600	330	60/250	10/5	0.25	50/5	200
FMMT455	160	140	1000	425	100/300	150/10	0.7	150/15	100
BSS64	120	80	100	330	20/–	10/1	0.15	4/0.4	100
HT2	90	80	100	330	50/–	10/1	0.75	50/5	100
PNP									
FMMTA92	300	300	200	330	25/–	30/10	0.5	20/2.0	50
FMMTA93	200	200	200	330	30/150	30/10	0.4	20/2.0	50
FMMT576	200	200	1000	425	50/300	300/10	0.3	100/10	100
FMMT555	160	150	1000	425	50/300	300/10	0.3	100/10	100
FMMT5401	160	150	600	330	60/240	10/5	0.5	50/5	200
FMMT5400	130	120	600	330	40/180	10/5	0.5	50/5	200
BSS63	110	100	100	330	30/–	10/1	0.25	25/2.5	85
HT3	90	80	100	330	50/–	10/1	0.75	50/5	100

DARLINGTON TRANSISTORS (NPN)

Type	V_{CBO} Volts	V_{CEO} Volts	I_C mA	P_{tot} mW	h_{FE} min.	h_{FE} at I_C/V_{CE} mA/volts	$V_{CE(sat)}$ max. at I_C/I_B Volts	$V_{CE(sat)}$ max. at I_C/I_B mA	f_T typ. MHz
FMMT38A	80	60	300	330	1K	500/5	1.25	800/8.0	100
FMMT38B	80	60	300	330	4K	500/5	1.25	800/8.0	100
FMMT38C	80	60	300	330	10K	500/5	1.25	800/8.0	100
BCV47	80	60	500	330	2K	500/5	1.0	100/0.1	170
BCV27	40	30	500	330	4K	500/5	1.0	100/0.1	170
FMMTA14	30	30	300	330	10K	10/5	1.5	100/0.1	100
FMMTA13	30	30	300	330	5K	10/5	1.5	100/0.1	100
FMMTA12	20	20	300	330	20K	10/5	1.0	10/0.01	100

DARLINGTON TRANSISTORS (PNP)

Type	V_{CBO} Volts	V_{CEO} Volts	I_C mA	P_{tot} mW	h_{FE} min.	h_{FE} at I_C/V_{CE} mA/volts	$V_{CE(sat)}$ max. at I_C/I_B Volts	$V_{CE(sat)}$ max. at I_C/I_B mA	f_T typ. MHz
BCV46	80	60	500	330	2K	500/5	1.0	100/0.1	200
BCV26	40	30	500	330	4K	500/5	1.0	100/0.1	200
FMMTA63	30	30	500	330	10K	10/5	1.5	100/0.1	150
FMMTA64	30	30	500	330	20K	10/5	1.5	100/0.1	150

SOT-23 TRANSISTORS & DIODES

HIGH PERFORMANCE TRANSISTORS (NPN)

Type	V_{CBO} Volts	V_{CEO} Volts	I_C mA	P_{tot} mW	h_{FE} min./max.	h_{FE} at I_C/V_{CE} mA/volts	$V_{CE(sat)}$ max. at I_C/I_B Volts	$V_{CE(sat)}$ max. at I_C/I_B mA	f_T min. MHz
FMMT497	300	300	500	500	100/300	100/10.0	0.2	100/10	75
FMMT495	170	150	1000	500	100/300	250/10.0	0.2	250/25	100
FMMT494	140	120	1000	500	100/300	250/10.0	0.2	250/25	100
FMMT493	120	100	1000	500	100/300	250/10.0	0.25	500/50	150
FMMT491	80	60	1000	500	100/300	500/5.0	0.3	500/50	150
FMMT491A	40	40	1000	500	300/900	500/5.0	0.3	500/50	150
FMMT489	50	30	1000	500	100/300	1000/2.0	0.3	1000/100	150

HIGH PERFORMANCE TRANSISTORS (PNP)

Type	V_{CBO} Volts	V_{CEO} Volts	I_C mA	P_{tot} mW	h_{FE} min./max.	h_{FE} at I_C/V_{CE} mA/volts	$V_{CE(sat)}$ max. at I_C/I_B Volts	$V_{CE(sat)}$ max. at I_C/I_B mA	f_T min. MHz
FMMT597	300	300	500	500	100/–	100/10.0	0.25	100/20	75
FMMT596	220	200	500	500	100/300	250/10.0	0.35	250/25	150
FMMT593	120	100	1000	500	100/300	500/10.0	0.3	500/50	150
FMMT591	80	60	1000	500	100/300	500/5.0	0.3	500/50	150
FMMT591A	40	40	1000	500	250/–	500/5.0	0.35	500/20	150
FMMT589	50	30	1000	500	80/–	1000/2.0	0.35	1000/100	100

MEDIUM POWER TRANSISTORS (NPN)

Type	V_{CBO} Volts	V_{CEO} Volts	I_C mA	P_{tot} mW	h_{FE} min./max.	h_{FE} at I_C/V_{CE} mA/volts	$V_{CE(sat)}$ max. at I_C/I_B Volts	$V_{CE(sat)}$ max. at I_C/I_B mA	f_T typ. MHz
BCX41	125	125	800	330	63/–	100/1	0.9	300/30	100
FMMTA06	80	80	500	330	50/–	100/1	0.25	100/10	100
FMMT451	80	60	1000	425	50/150	150/10	0.35	150/15	150
BCW66F	75	45	800	330	100/250	100/1	0.3	100/10	100
BCW66G	75	45	800	330	160/400	100/1	0.3	100/10	100
BCW66H	75	45	800	330	250/630	100/1	0.3	100/10	100
FMMTA05	60	60	500	330	50/–	100/1	0.25	100/10	100
BCW65A	60	32	800	330	100/250	100/1	0.3	100/10	100
BCW65B	60	32	800	330	160/400	100/1	0.3	100/10	100
BCW65C	60	32	800	330	250/630	100/1	0.3	100/10	100
BCX19	50	45	500	330	100/600	100/1	0.62	500/50	200
FMMT449	35	30	1000	425	100/300	500/2	0.5	1000/100	150
BCX20	30	25	500	330	100/600	100/1	0.62	500/50	200

MEDIUM POWER TRANSISTORS (PNP)

Type	V_{CBO} Volts	V_{CEO} Volts	I_C mA	P_{tot} mW	h_{FE} min./max.	h_{FE} at I_C/V_{CE} mA/volts	$V_{CE(sat)}$ max. at I_C/I_B Volts	$V_{CE(sat)}$ max. at I_C/I_B mA	f_T typ. MHz
FMMTA56	80	80	500	330	50/–	100/1	0.25	100/10	100
FMMT551	80	60	1000	425	50/150	150/10	0.35	150/15	150
FMMTA55	60	60	500	330	50/–	100/1	0.25	100/10	100
BCW68F	60	45	800	330	100/250	100/1	0.3	100/10	100
BCW68G	60	45	800	330	160/400	100/1	0.3	100/10	100
BCW68H	60	45	800	330	250/630	100/1	0.3	100/10	100
BCX17	50	45	800	330	100/600	100/1	0.62	500/50	100
BCW67A	45	30	800	330	100/250	100/1	0.3	100/10	100
BCW67B	45	30	800	330	160/400	100/1	0.3	100/10	100
BCW67C	45	30	800	330	250/630	100/1	0.3	100/10	100
FMMT549A	35	30	1000	425	150/500	500/2	0.5	1000/100	100
FMMT549	35	30	1000	425	100/300	500/2	0.5	1000/100	100
BCX18	30	25	800	330	100/600	100/1	0.62	500/50	100

SOT-23 TRANSISTORS & DIODES

SWITCHING TRANSISTORS (NPN)

Type	V_{CBO} Volts	V_{CEO} Volts	I_C mA	P_{tot} mW	h_{FE} min./max.	h_{FE} at I_C/V_{CE} mA/volts	$V_{CE(sat)}$ max. at I_C/I_B Volts	$V_{CE(sat)}$ max. at I_C/I_B mA	f_T typ. MHz
BSS79B	75	40	800	330	40/120	150/10	0.3	150/15	250
BSS79C	75	40	800	330	100/300	150/10	0.3	150/15	250
FMMT2222A	75	40	600	330	100/300	150/10	0.3	150/15	300
FMMT4400	60	40	600	330	50/150	150/1	0.4	150/15	200
FMMT4401	60	40	600	330	100/300	150/1	0.4	150/15	200
BSS66	60	40	100	330	50/150	10/1	0.2	10/1	250
BSS67	60	40	100	330	100/300	10/1	0.2	10/1	300
FMMT3903	60	40	200	330	50/150	10/1	0.2	10/1	250
FMMT3904	60	40	200	330	100/300	10/1	0.2	10/1	300
FMMT2222	60	30	600	330	100/300	150/10	0.4	150/15	250
FMMT4123	40	30	200	330	50/150	2/1	0.3	50/5	250
FMMT4124	30	25	200	330	120/360	2/1	0.3	50/5	300
FMMT2369A	40	15	200	330	40/120	10/1	0.2	10/1	500
FMMT2369	40	15	200	330	40/120	10/1	0.25	10/1	500
BSV52	20	12	100	330	40/120	10/1	0.25	10/1	500

SMALL SIGNAL MOSFETS (SOTFETs*) (N-Channel)

Part Number	BV_{DSS} V	I_D mA	I_{DM} A	P_D mW	$V_{GS(th)}$ V min.	$V_{GS(th)}$ at max	I_D mA	$R_{DS(on)}$ Ω max. at	$R_{DS(on)}$ I_D mA	V_{GS} V
ZVN3320F	200	60	1	330	1	3	1	25	100	10
BSS123	100	170	0.68	360	0.8	2.8	1	6	100	10
ZVN3310F	100	100	2	330	0.8	2.4	1	10	500	10
ZVN4106F	60	200	3	330	1.3	3	1	2.5	500	10
ZVN3306F	60	150	3	330	0.8	2.4	1	5	500	10
2N7002	60	115	2	330	1	2.5	0.25	7.5	50	5
VN10LF	60	150	3	330	0.8	2.5	1	7.5	200	5
BS170F	60	150	3	330	0.8	3	1	5	200	10
BSS138§	50	200	0.8	360	0.5	1.5	1	3.5	200	5

SMALL SIGNAL MOSFETS (SOTFETs*) (P-Channel)

Part Number	BV_{DSS} V	I_D mA	I_{DM} A	P_D mW	$V_{GS(th)}$ V min.	$V_{GS(th)}$ at max	I_D mA	$R_{DS(on)}$ Ω max. at	$R_{DS(on)}$ I_D mA	V_{GS} V
ZVP1320F	−200	−35	−0.4	330	−1.5	−3.5	−1	80	−50	−10
ZVP3310F	−100	−75	−1.2	330	−1.5	−3.5	−1	20	−150	−10
ZVP3306F	−60	−90	−1.6	330	−1.5	−3.5	−1	14	−200	−10
BSS84§	−50	−130	−0.52	360	−0.8	−2.0	−1	10	−100	−5
BS250F	−45	−90	−1.6	330	−1.5	−3.5	−1	14	−200	−10

*SOTFETs is a trademark of Zetex plc
§New product information

SOT-23 TRANSISTORS & DIODES

SCHOTTKY BARRIER DIODES

Type	V_{BR} at I_R = 10μA min. (Volts)	V_F at I_F = 1mA max. (mV)	I_R max. nA at V_R (volts)		I_F at V_F = 1V min. (mA)	C_T at V_R = 0V f = 1MHz max. (pF)
ZC2800E	70	410	200	50	15	2.0
*ZC2810E	20	410	100	15	35	1.2
ZC2811E	15	410	100	10	20	1.2
ZC5800E	50	410	200	35	15	2.0

*Not recommended for New Design - In (ZC2810E)

DUAL SCHOTTKY BARRIER DIODES

Type	V_{BR} at I_R = 10μA min. (Volts)	V_F at I_F = 1mA max. (mV)	I_R max. nA at V_R (volts)		I_F at V_F = 1V min. (mA)	C_T at V_R = 0V f = 1MHz max. (pF)	Pinning configuration
BAS70-04	70	410	200	50	15	2.0	Series
BAS70-05	70	410	200	50	15	2.0	Common cathode
BAS70-06	70	410	200	50	15	2.0	Common anode

SILICON ION IMPLANTED HYPERABRUPT TUNER DIODES

Type	Reverse breakdown Voltage V_R Volts max.	Nominal capacitance at V_R = 2V, f = 1MHz C_{tot} pF min.	typ.	max.	Capacitance ratio f = 1MHz C_2/C_{20} min.	max.	Q at V_R = 3V f = 50MHz min.
ZC830A	25	9.0	10	11.0	4.5	6.0	300
ZC831A	25	13.5	15	16.5	4.5	6.0	300
ZC832A	25	19.8	22	24.2	5.0	6.5	200
ZC833A	25	29.7	33	36.3	5.0	6.5	200
ZC834A	25	42.3	47	51.7	5.0	6.5	200
ZC835A	25	61.2	68	74.8	5.0	6.5	100
ZC836A	25	90.0	100	110.0	5.0	6.5	100

Devices are also available with 5% and 20% tolerances. No suffix – ±20% (e.g. ZC830)
Suffix B – ±5% (e.g. ZC830B)

VARIABLE CAPACITANCE TUNER DIODES

Type	Reverse Breakdown Voltage V_R Volts	Nominal Capacitance at f = 1 MHz C_{tot} pF Min.	Typ.	Max.	at V_R Volts	Capacitance ratio at f = 1 MHz C_3/C_{25} Min.	Typ.	Max.	Q at V_R = 3V f = 50 MHz Typ.
BBY31	28	1.8	–	2.8	25	–	5.0	–	–
BBY40	28	26	–	32	3	5	–	6.5	–
		4.3	–	6.0	25				
FMMV105G	30	1.8	–	2.8	25	4.0	–	6.0	350
FMMV109	30	26	–	32	3	5.0	–	6.5	250
FMMV3102	30	26	–	25	3	4.5	–	–	300

SOT-23 TRANSISTORS & DIODES

SILICON ABRUPT TUNER DIODES

Type	Reverse breakdown Voltage V_R Volts max.	Nominal capacitance at V_R=2V, f=1MHz C_{tot} pF min.	typ.	max.	Capacitance ratio f=1MHz C_2/C_{20} min.	Q at V_R=3V f=50MHz min.
FMMV2101	30	6.12	6.8	7.48	2.7	450
FMMV2102	30	7.4	8.2	9.1	2.7	450
FMMV2103	30	9.0	10.0	11.0	2.7	400
FMMV2104	30	10.8	12.0	13.2	2.8	400
FMMV2105	30	13.5	15.0	16.5	2.8	400
FMMV2106	30	16.2	18.0	19.8	2.8	350
FMMV2107	30	19.8	22.0	24.2	2.8	350
FMMV2108	30	24.3	27.0	29.7	2.8	300
FMMV2109	30	29.7	33.0	36.3	2.8	200

ZENER DIODES

Type	Range (V)	Voltage tolerance %	P_{tot} mW	I_{ZRM} mA	I_{FRM} mA
BZX84	2V7 to 47V	5 or 10	330	200	200
FMMZ5232-5257	5V6 to 33V	5	330	200	200

SILICON PLANAR HIGH SPEED SWITCHING DIODES

Type	Description	Ratings V_R Volts	I_F mA	t_{rr} max. ns	Max. V_F at I_F=mA 10 50 100
BAS21	Single diode	200	200	50	–/–/1.0
BAS20	Single diode	150	200	50	–/–/1.0
BAS19	Single diode	100	200	50	–/–/1.0
BAS16	Single diode	75	100	6	0.855/1.0/–
FMMD914	Single diode	75	75	4/8	1.0/–/–
HD3A	Single diode	75	100	6	1.0/–/–
BAL99	Single diode	70	100	6	0.855/1.1/1.3
BAR99	Single diode	70	100	6	0.855/1.1/1.3
BAL74	Single diode	50	150	4	–/–/1.0
BAR74	Single diode	50	150	4	–/–/1.0
FMMD6050	Single diode	70	100	6	–/–/1.1
FMMD6100	Dual diode with common cathode	70	200	5	0.7/–/1.1
BAV70	Dual diode with common cathode	70	100	6	0.855/1.1/1.3
BAV74	Dual diode with common cathode	50	150	4	–/–/1.0
HD2A	Dual diode with common cathode	75	100	6	1.0/–/–
FMMD2837	Dual diode with common cathode	30	100	6	1.0/1.0/1.2
FMMD2838	Dual diode with common cathode	50	100	6	1.0/1.0/1.2
BAV99	Dual diode with series connection	70	100	6	0.855/1.1/1.3
FMMD7000	Dual diode with series connection	70	200	15	0.7/–/1.1
BAW56	Dual diode with common anode	70	100	6	0.855/1.1/1.3
HD4A	Dual diode with common anode	75	100	6	1.0/–/–
FMMD2836	Dual diode with common anode	75	100	6	1.0/1.0/1.2
FMMD2835	Dual diode with common anode	35	100	6	1.0/1.0/1.2

SOT-23 TRANSISTORS & DIODES

CROSS REFERENCE LIST

This cross reference list is intended as a guide to the selection of a direct or near equivalent device from the extensive range of Ferranti SOT-23 products.

INDUSTRY PART NO.	ZETEX PART NO.	INDUSTRY PART NO.	ZETEX PART NO.	INDUSTRY PART NO.	ZETEX PART NO.
1S2835	**FMMD2835**	BCF32	**BC849B**	BFN23	**FMMTA92**
1S2836	**FMMD2836**	BCF33	**BC849C**	BFN24	**FMMTA42**
1S2837	**FMMD2837**	BCF70	**BC860B**	BFN25	**FMMTA92**
1S2838	**FMMD2838**	BCF81	**BC850C**	BFN26	**FMMTA42**
BAL74	**BAL74**	BCV27	**FMMTA14**	BFN27	**FMMTA92**
BAR74	**BAR74**	BCV47	**FMMT38A**	BFQ31	**BFQ31**
BAL99	**BAL99**	BCV71	**BCV71**	BFQ31A	**BFQ31A**
BAR99	**BAR99**	BCV72	**BCV72**	BSR13	**FMMT2222**
BAS16	**BAS16**	BCW29	**BCW29**	BSR14	**FMMT2222A**
BAS19	**BAS19**	BCW30	**BCW30**	BSR15	**FMMT2907**
BAS20	**BAS20**	BCW31	**BCW31**	BSR16	**FMMT2907A**
BAS21	**BAS21**	BCW32	**BCW32**	BSR17	**FMMT3903**
BAS29	**BAS19**	BCW33	**BCW33**	BSR17A	**FMMT3904**
BAS31	**BAS19 SERIES**	BCW60A	**BCW60A**	BSR18	**FMMT3905**
BAS35	**BAS19** COMMON ANODE	BCW60B	**BCW60B**	BSR18A	**FMMT3906**
BAT17	**ZC2811E**	BCW60C	**BCW60C**	BSS63	**BSS63**
BAT18	**BAS16**	BCW60D	**BCW60D**	BSS64	**BSS64**
BAV70	**BAV70**	BCW61A	**BCW61A**	BSS65	**BSS65**
BAV74	**BAV74**	BCW61B	**BCW61B**	BSS66	**BSS66**
BAV99	**BAV99**	BCW61C	**BCW61C**	BSS67	**BSS67**
BAW56	**BAW56**	BCW61D	**BCW61D**	BSS69	**BSS69**
BAY84	**FMMD7000**	BCW65A	**BCW65A**	BSS70	**BSS70**
BC807	**BCX17**	BCW65B	**BCW65B**	BSS79B	**BSS79B**
BC808	**BCX18**	BCW65C	**BCW65C**	BSS79C	**BSS79C**
BC817	**BCX19**	BCW66F	**BCW66F**	BSS80B	**BSS80B**
BC818	**BCX20**	BCW66G	**BCW66G**	BSS80C	**BSS80C**
BC846A	**BC846A**	BCW66H	**BCW66H**	BSS82B	**BSS82B**
BC846B	**BC846B**	BCW67A	**BCW67A**	BSS82C	**BSS82C**
BC847A	**BC847A**	BCW67B	**BCW67B**	BSS123	**ZVN3306F**
BC847B	**BC847B**	BCW67C	**BCW67C**	BST82	**ZVN3310F**
BC848A	**BC848A**	BCW68F	**BCW68F**	BS170F	**BS170F**
BC848B	**BC848B**	BCW68G	**BCW68G**	BS250F	**BS250F**
BC848C	**BC848C**	BCW68H	**BCW68H**	BSV52	**BSV52**
BC849B	**BC849B**	BCW69	**BCW69**	BZX84C10	**BZX84C10**
BC849C	**BC849C**	BCW70	**BCW70**	BZX84C11	**BZX84C11**
BC850B	**BC850B**	BCW71	**BCW71**	BZX84C12	**BZX84C12**
BC850C	**BC850C**	BCW72	**BCW72**	BZX84C13	**BZX84C13**
BC856A	**BC856A**	BCW89	**BCW89**	BZX84C15	**BZX84C15**
BC856B	**BC856B**	BCX17	**BCX17**	BZX84C16	**BZX84C16**
BC857A	**BC857A**	BCX18	**BCX18**	BZX84C18	**BZX84C18**
BC857B	**BC857B**	BCX19	**BCX19**	BZX84C20	**BZX84C20**
BC857C	**BC857C**	BCX20	**BCX20**	BZX84C22	**BZX84C22**
BC858A	**BC858A**	BCX41	**BCX41**	BZX84C24	**BZX84C24**
BC858B	**BC858B**	BCX70G	**BCX70G**	BZX84C27	**BZX84C27**
BC858C	**BC858C**	BCX70H	**BCX70H**	BZX84C30	**BZX84C30**
BC859A	**BC859A**	BCX70J	**BCX70J**	BZX84C33	**BZX84C33**
BC859B	**BC859B**	BCX70K	**BCX70K**	BZX84C36	**BZX84C36**
BC859C	**BC859C**	BCX71G	**BCX71G**	BZX84C39	**BZX84C39**
BC860A	**BC860A**	BCX71H	**BCX71H**	BZX84C43	**BZX84C43**
BC860B	**BC860B**	BCX71J	**BCX71J**	BZX84C47	**BZX84C47**
BC860C	**BC860C**	BCX71K	**BCX71K**	BZX84C2V7	**BZX84C2V7**
BCF30	**BC859B**	BFN22	**FMMTA42**	BZX84C3V0	**BZX84C3V0**

SOT-23 TRANSISTORS & DIODES

CROSS REFERENCE LIST (Cont.)

INDUSTRY PART NO.	ZETEX PART NO.	INDUSTRY PART NO.	ZETEX PART NO.	INDUSTRY PART NO.	ZETEX PART NO.
BZX84C3V3	**BZX84C3V3**	FMMTA70	**FMMTA70**	MMBTA13	**FMMTA13**
BZX84C3V6	**BZX84C3V6**	FMMTA92	**FMMTA92**	MMBTA14	**FMMTA14**
BZX84C3V9	**BZX84C3V9**	FMMTA93	**FMMTA93**	MMBTA20	**FMMTA20**
BZX84C4V3	**BZX84C4V3**	FMMV2101	**FMMV2101**	MMBTA42	**FMMTA42**
BZX84C4V7	**BZX84C4V7**	FMMV2102	**FMMV2102**	MMBTA43	**FMMTA43**
BZX84C5V1	**BZX84C5V1**	FMMV2103	**FMMV2103**	MMBTA55	**FMMTA55**
BZX84C5V6	**BZX84C5V6**	FMMV2104	**FMMV2104**	MMBTA56	**FMMTA56**
BZX84C6V2	**BZX84C6V2**	FMMV2105	**FMMV2105**	MMBTA70	**FMMTA70**
BZX84C6V8	**BZX84C6V8**	FMMV2106	**FMMV2106**	MMBTA92	**FMMTA92**
BZX84C7V5	**BZX84C7V5**	FMMV2107	**FMMV2107**	MMBTA93	**FMMTA93**
BZX84C8V2	**BZX84C8V2**	FMMV2108	**FMMV2108**	MMBT918	**FMMT918**
BZX84C9V1	**BZX84C9V1**	FMMV2109	**FMMV2109**	MMBT2222	**FMMT2222**
FMMD914	**FMMD914**	FMMZ5232	**FMMZ5232**	MMBT2222A	**FMMT2222A**
FMMD2835	**FMMD2835**	FMMZ5233	**FMMZ5233**	MMBT2369	**FMMT2369**
FMMD6050	**FMMD6050**	FMMZ5234	**FMMZ5234**	MMBT2484	**FMMT2484**
FMMD6100	**FMMD6100**	FMMZ5235	**FMMZ5235**	MMBT2907	**FMMT2907**
FMMD7000	**FMMD7000**	FMMZ5236	**FMMZ5236**	MMBT2907A	**FMMT2907A**
FMMT38A	**FMMT38A**	FMMZ5237	**FMMZ5237**	MMBT3640	**BSS65**
FMMT38B	**FMMT38B**	FMMZ5238	**FMMZ5238**	MMBT3903	**FMMT3903**
FMMT38C	**FMMT38C**	FMMZ5239	**FMMZ5239**	MMBT3904	**FMMT3904**
FMMT2222	**FMMT2222**	FMMZ5240	**FMMZ5240**	MMBT3906	**FMMT3906**
FMMT2222A	**FMMT2222A**	FMMZ5241	**FMMZ5241**	MMBT4124	**FMMT4124**
FMMT2369	**FMMT2369**	FMMZ5242	**FMMZ5242**	MMBT4125	**FMMT4125**
FMMT2369A	**FMMT2369A**	FMMZ5243	**FMMZ5243**	MMBT4401	**FMMT4401**
FMMT2484	**FMMT2484**	FMMZ5244	**FMMZ5244**	MMBT4403	**FMMT4403**
FMMT2907	**FMMT2907**	FMMZ5245	**FMMZ5245**	MMBT5086	**FMMT5086**
FMMT2907A	**FMMT2907A**	FMMZ5246	**FMMZ5246**	MMBT5087	**FMMT5087**
FMMT3903	**FMMT3903**	FMMZ5247	**FMMZ5247**	MMBT5088	**FMMT5088**
FMMT3904	**FMMT3904**	FMMZ5248	**FMMZ5248**	MMBT5089	**FMMT5089**
FMMT3905	**FMMT3905**	FMMZ5249	**FMMZ5249**	MMBV2101	**FMMV2101**
FMMT3906	**FMMT3906**	FMMZ5250	**FMMZ5250**	MMBV2102	**FMMV2102**
FMMT4123	**FMMT4123**	FMMZ5251	**FMMZ5251**	MMBV2103	**FMMV2103**
FMMT4124	**FMMT4124**	FMMZ5252	**FMMZ5252**	MMBV2104	**FMMV2104**
FMMT4125	**FMMT4125**	FMMZ5253	**FMMZ5253**	MMBV2105	**FMMV2105**
FMMT4126	**FMMT4126**	FMMZ5254	**FMMZ5254**	MMBV2106	**FMMV2106**
FMMT4400	**FMMT4400**	FMMZ5255	**FMMZ5255**	MMBV2107	**FMMV2107**
FMMT4401	**FMMT4401**	FMMZ5256	**FMMZ5256**	MMBV2108	**FMMV2108**
FMMT4402	**FMMT4402**	FMMZ5257	**FMMZ5257**	MMBV2109	**FMMV2109**
FMMT4403	**FMMT4403**	HD2A	**HD2A**	MMBZ5226	**BZX84C3V3**
FMMT5087	**FMMT5087**	HD3A	**HD3A**	MMBZ5227	**BZX84C3V6**
FMMT5088	**FMMT5088**	HD4A	**HD4A**	MMBZ5228	**BZX84C3V9**
FMMT5089	**FMMT5089**	HT2	**HT2**	MMBZ5229	**BZX84C4V3**
FMMT5209	**FMMT5209**	HT3	**HT3**	MMBZ5230	**BZX84C4V7**
FMMT5210	**FMMT5210**	MMBD101	**ZC5800E**	MMBZ5231	**BZX84C5V1**
FMMT918	**FMMT918**	MMBD501	**ZC5800E**	MMBZ5232	**FMMZ5232**
FMMTA05	**FMMTA05**	MMBD914	**FMMD914**	MMBZ5233	**FMMZ5233**
FMMTA06	**FMMTA06**	MMBD2835	**FMMD2835**	MMBZ5234	**FMMZ5234**
FMMTA12	**FMMTA12**	MMBD2836	**FMMD2836**	MMBZ5235	**FMMZ5235**
FMMTA13	**FMMTA13**	MMBD2837	**FMMD2837**	MMBZ5236	**FMMZ5236**
FMMTA14	**FMMTA14**	MMBD2838	**FMMD2838**	MMBZ5237	**FMMZ5237**
FMMTA20	**FMMTA20**	MMBD6050	**FMMD6050**	MMBZ5238	**FMMZ5238**
FMMTA42	**FMMTA42**	MMBD6100	**FMMD6100**	MMBZ5239	**FMMZ5239**
FMMTA43	**FMMTA43**	MMBD7000	**FMMD7000**	MMBZ5240	**FMMZ5240**
FMMTA55	**FMMTA55**	MMBTA05	**FMMTA05**	MMBZ5241	**FMMZ5241**
FMMTA56	**FMMTA56**	MMBTA06	**FMMTA06**	MMBZ5242	**FMMZ5242**

SOT-23 TRANSISTORS & DIODES

CROSS REFERENCE LIST (Cont.)

INDUSTRY PART NO.	ZETEX PART NO.	INDUSTRY PART NO.	ZETEX PART NO.	INDUSTRY PART NO.	ZETEX PART NO.
MMBZ5243	**FMMZ5243**	MMT3903	**FMMT3903**	SO5551	**BCX41**
MMBZ5244	**FMMZ5244**	MMT3904	**FMMT3904**	TMPD914	**FMMD914**
MMBZ5245	**FMMZ5245**	MMT3905	**FMMT3905**	TMPD2835	**FMMD2835**
MMBZ5246	**FMMZ5246**	MMT3906	**FMMT3906**	TMPD2836	**FMMD2836**
MMBZ5247	**FMMZ5247**	MMT4123	**FMMT4123**	TMPD2837	**FMMD2837**
MMBZ5248	**FMMZ5248**	MMT4124	**FMMT4124**	TMPD2838	**FMMD2838**
MMBZ5249	**FMMZ5249**	MMT4125	**FMMT4125**	TMPD6050	**FMMD6050**
MMBZ5250	**FMMZ5250**	MMT4126	**FMMT4126**	TMPD6100	**FMMD6100**
MMBZ5251	**FMMZ5251**	MMT4400	**FMMT4400**	TMPT2222	**FMMT2222**
MMBZ5252	**FMMZ5252**	MMT4401	**FMMT4401**	TMPT2222A	**FMMT2222A**
MMBZ5253	**FMMZ5253**	MMT4402	**FMMT4402**	TMPT2907A	**FMMT2907A**
MMBZ5254	**FMMZ5254**	MMT4403	**FMMT4403**	TMPT3904	**FMMT3904**
MMBZ5255	**FMMZ5255**	MMT5086	**FMMT5086**	TMPT3906	**FMMT3906**
MMBZ5256	**FMMZ5256**	MMT5087	**FMMT5087**	TMPT4403	**FMMT4403**
MMBZ5257	**FMMZ5257**	MMT5088	**FMMT5088**	TMPT5086	**FMMT5086**
MMST918	**FMMT918**	MMT5089	**FMMT5089**	TMPT5087	**FMMT5087**
MMST2222	**FMMT2222**	MMT6428	**BCX70J**	TMPT5088	**FMMT5088**
MMST2222A	**FMMT2222A**	MMT6429	**BCX70K**	TMPT5089	**FMMT5089**
MMST2907	**FMMT2907**	MST4123	**FMMT4123**	TMPT5550	**BCX41**
MMST2907A	**FMMT2907A**	MST4124	**FMMT4124**	TMPT6428	**BCX70J**
MMST3904	**FMMT3904**	MSTA55	**FMMTA55**	TMPT6429	**BXC70K**
MMST3906	**FMMT3906**	MSTA56	**FMMTA56**	TMPTA05	**FMMTA05**
MMST4125	**FMMT4125**	MTM3906	**FMMT3906**	TMPTA06	**FMMTA06**
MMST4126	**FMMT4126**	NTM2222A	**FMMT2222A**	TMPTA13	**FMMTA13**
MMST4400	**FMMT4400**	NTM2369	**FMMT2369**	TMPTA14	**FMMTA14**
MMST4401	**MMST4401**	NTM2907A	**FMMT2909A**	TMPTA20	**FMMTA20**
MMST4402	**FMMT4402**	NTM3904	**FMMT3904**	TMPTA42	**FMMTA42**
MMST4403	**FMMT4403**	SMBT2222	**FMMT2222**	TMPTA43	**FMMTA43**
MMST5086	**FMMT5086**	SMBT2222A	**FMMT2222A**	TMPTA55	**FMMTA55**
MMST5088	**FMMT5088**	SMBT2907	**FMMT2907**	TMPTA56	**FMMTA56**
MMST5089	**FMMT5089**	SMBT2907A	**FMMT2907A**	TMPTA70	**FMMTA70**
MMST6428	**BCX70J**	SMBT3904	**FMMT3904**	TMPTA92	**FMMTA92**
MMST6429	**BCX70K**	SMBT3906	**FMMT3906**	ZC2800E	**ZC2800E**
MMSTA05	**FMMTA05**	SMBTA05	**FMMTA05**	ZC2811E	**ZC2811E**
MMSTA06	**FMMTA06**	SMBTA06	**FMMTA06**	ZC5800E	**ZC5800E**
MMSTA12	**FMMTA12**	SMBTA13	**FMMTA13**	ZC830	**ZC830**
MMSTA13	**FMMTA13**	SMBTA14	**FMMTA14**	ZC831	**ZC831**
MMSTA14	**FMMTA14**	SMBTA20	**FMMTA20**	ZC832	**ZC832**
MMSTA20	**FMMTA20**	SMBTA42	**FMMTA42**	ZC833	**ZC833**
MMSTA55	**FMMTA55**	SMBTA43	**FMMTA43**	ZC834	**ZC834**
MMSTA56	**FMMTA56**	SMBTA55	**FMMTA55**	ZC835	**ZC835**
MMSTA70	**FMMTA70**	SMBTA56	**FMMTA56**	ZC836	**ZC836**
MMTA05	**FMMTA05**	SMBTA92	**FMMTA92**	2N7001	**ZVN3320F**
MMTA06	**FMMTA06**	SMBTA93	**FMMTA93**	2N7002	**2N7002**
MMTA12	**FMMTA12**	SO914	**FMMD914**		
MMTA13	**FMMTA13**	SO918	**FMMT918**		
MMTA20	**FMMTA20**	SO1711	**FMMT2222A**		
MMTA55	**FMMTA55**	SO1893	**FMMT2222A**		
MMTA56	**FMMTA56**	SO2221	**FMMT2222A**		
MMTA70	**FMMTA70**	SO2221A	**FMMT2222A**		
MMT918	**FMMT918**	SO2907	**FMMT2907**		
MMT2222	**FMMT2222**	SO2907A	**FMMT2907A**		
MMT2222A	**FMMT2222A**	SO3904	**FMMT3904**		
MMT2907	**FMMT2907**	SO3906	**FMMT3906**		
MMT2907A	**FMMT2907A**	SO5550	**BCX41**		

ENVIRONMENTAL DATA

We are engaged in on-going reliability exercises to ensure long term reliability of its semiconductor components.

The table below details some of the tests carried out on a periodic basis on the SOT-23 product range, either as part of the on-going BS/CECC and D3007 (20 year life) programmes or as part of the Special Customer Requirement programmes.

The results of these tests can be made available upon request together with results from other tests additional to those in the table below (e.g. Intermittent Operating Life, Thermal Shock, etc.).

Environmental Tests

High Temperature Damp Heat (No Bias)	85°C/85% RH Duration 1000 hours minimum
Electrical Endurance	Duration 1000 hours minimum as per BS/CECC 50000-4.5.2.3
High Temperature Storage	Duration 1000 hours minimum at 150°C as per BS/CECC 50000-4.4.1
High Temperature Storage (20 years life requirement)	Duration 3100 hours minimum at 200°C as per BS/CECC 50000-4.4.1.
Temperature Cycling	400 cycles minimum −55 to +150°C. Method IEC 68-2-14 Test Na
High Temperature Damp Heat (with bias)	85°C/85% RH + Bias Duration 2000 hours minimum.
Autoclave (Pressure Cooker)	Duration 100 hours minimum TA=+121°C, +1 Bar
Temperature Cycling	−40°C to +125°C, 3 mins. ramp Duration 1000 cycles minimum

The methods quoted are compatible with MILSTD750.

Solderability

	Meets the requirements of
Plating material — **Tin/lead Sn/Pb**	BS2011 IEC68-2-20T
Composition — **Nominal 65/35**	MIL-STD-202 Method 208 MIL-STD-750 Method 2026
Thickness of composition — **Nominal 350μ inches**	Including Steam Pre-Age of components

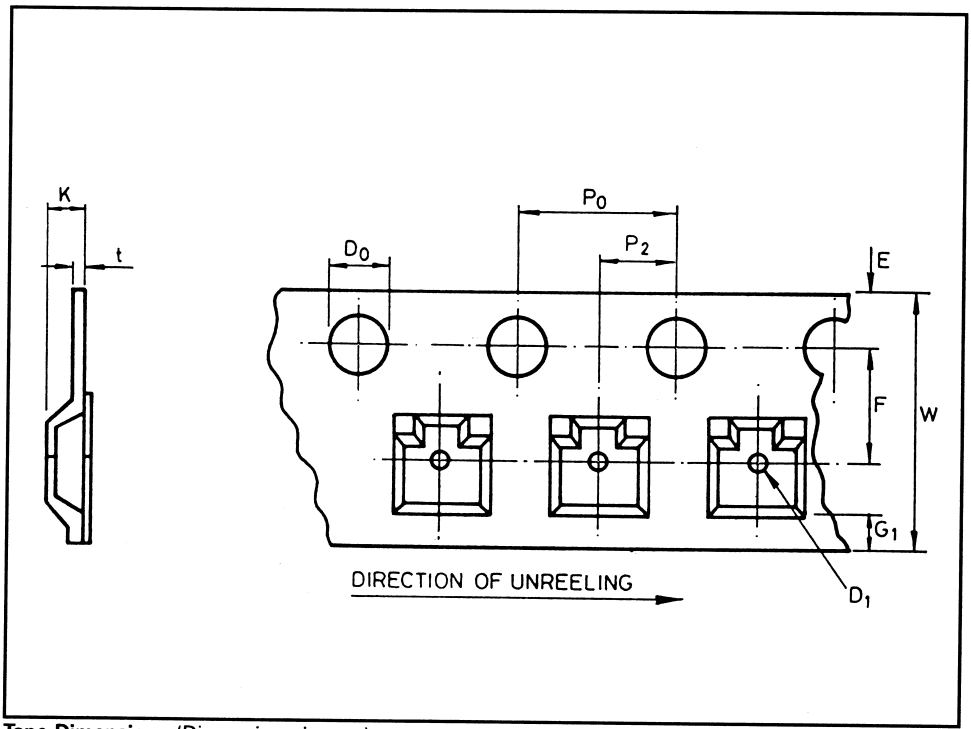
SOT-23 TRANSISTORS & DIODES

SOT-23 TAPE AND REEL INFORMATION

The complete range of SOT-23 devices is available on 8mm tape for use with automatic placement equipment.

Tape packaging also has special attractions for customers using manual placement since it makes it easier to assemble and orientate these tiny components; stock accounting is also simplified.

Tape Specification

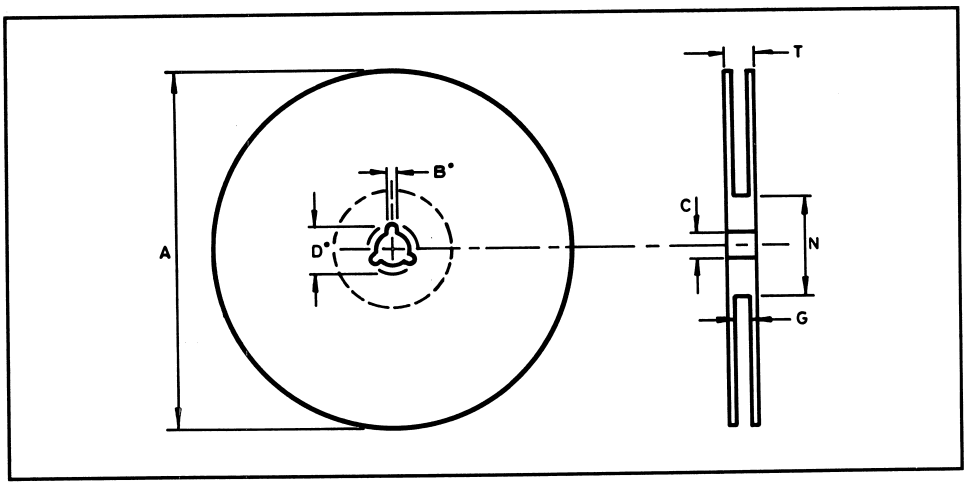


Tape Dimensions (Dimensions in mm)

D^0	E	P_0	t(max)	$D_{1(min)}$	F	K(max)	P_2	$G_{1(min)}$	W
$1.5^{+0.05}_{-0.00}$	1.75±0.10	4.0±0.10	0.30	1.0	3.5±0.05	2.40	2.0±0.05	0.75	8.0±0.30

SOT-23 TAPE AND REEL INFORMATION

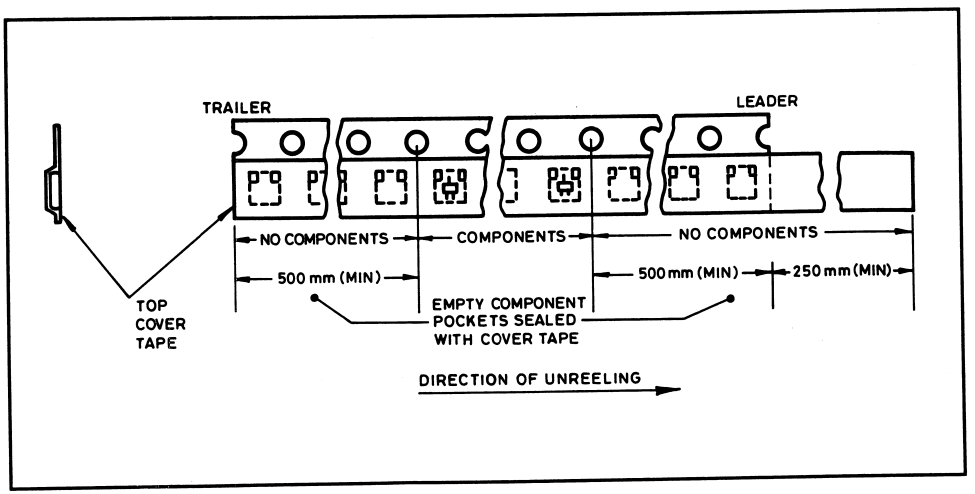
Reel Specifications



Reel Dimensions (Dimensions in mm)

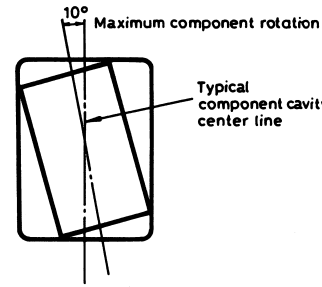
A(max)	B(min)	C	D(min)	N	G	T(max)
180 or 330	1.5	13.0±0.2	20.2	62±1.5	$8.4^{+1.5}_{-0.0}$	14.4

Leader and Trailer Tape Details

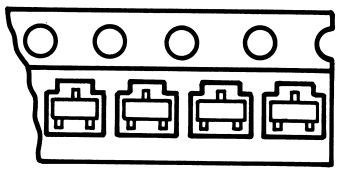


SOT-23 TRANSISTORS & DIODES

TAPE FEATURES



- Collector Locating Tape (option A only).
  (This special feature centralises the component in the pocket for improved pick-up).
  Less than 10° Component Rotation
- Semi-conductive Carrier Tape Resistivity Values $<10^7\Omega/\square$
- Available in both 7" and 13" diameter reels.
  7" — 3,000 components (e.g. BAV99TA).
  13" — 10,000 components (e.g. BAV99TC).
- Maximum of 0.25% missing devices/Reel.
- There will be no consecutive missing components between the first and the last component of the reel.
- Tape complies with both EIA481 and IEC286 Industry Standard Taping Specifications.
- Component Orientation



Option 'A'
"The Industry Standard"

Ordering Format

Suffix 'T' followed by 'A' (e.g. FMMT3904TA on 7" reels).

Suffix 'T' followed by 'C' (e.g. FMMT3904TC on 13" reels).

SOT-23 TRANSISTORS & DIODES

ELECTRICAL SPECIFICATIONS

High speed switching diode

BAL74

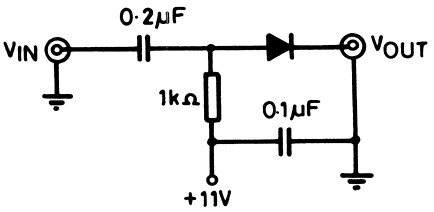
ABSOLUTE MAXIMUM RATINGS

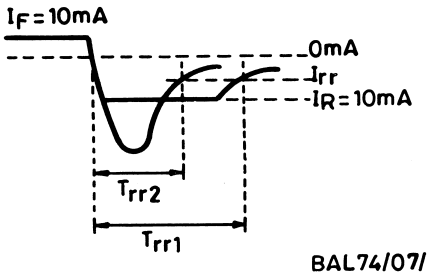
Parameter	Symbol	BAL74	Unit
Continuous reverse voltage	V_R	50	V
Average output rectified current (t_{AV}=10ms)	I_o	100	mA
Continuous forward current	I_F	150	mA
Peak forward current (t=15ms)	I_{FM}	200	mA
Forward surge current (t=1μs)	I_{FS}	1	A

CHARACTERISTICS (at T_{amb}=25°C unless otherwise specified).

Parameter	Symbol	Min.	Max.	Unit	Test conditions
Breakdown voltage	V_{BR}	51	–	V	I_R=5μA
Forward voltage	V_F	–	1.0	V	I_F=100mA
Reverse current	I_R	– –	0.1 100	μA μA	V_R=50V V_R=50V, T_{amb}=125°C
Capacitance	C_o	–	2.0	pF	V_R=0
Reverse recovery time	t_{rr}	– –	4 2	ns ns	I_F=I_R=10mA, I_{rr}=1mA I_F=10mA, V_R=6V, R_L=100Ω

Circuit for measuring switching time





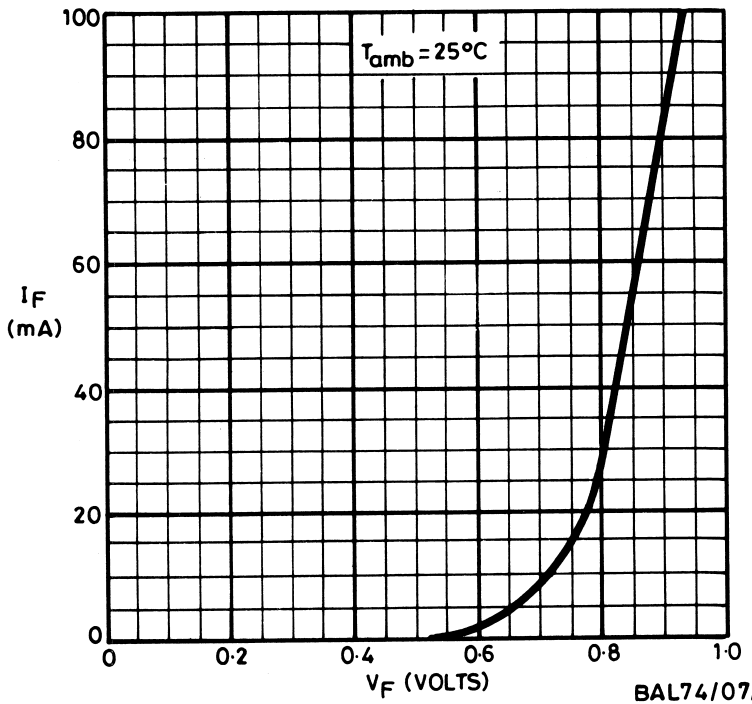
BAL74/07/86

Pulse is supplied by a generator with the following characteristics:

Output impedance = 50Ω
Rise time ⩽0.5ns
Pulse width = 100ns

Output is monitored on a sampling oscilloscope with the following characteristics:

Rise time ⩽0.6ns
Input impedance = 50Ω



BAL74/07/86

PIN CONFIGURATION

BAL74/07/86

Devices are identified by a code on the body of the device

BAL74 . . . . . JC

High speed switching diode

BAL99

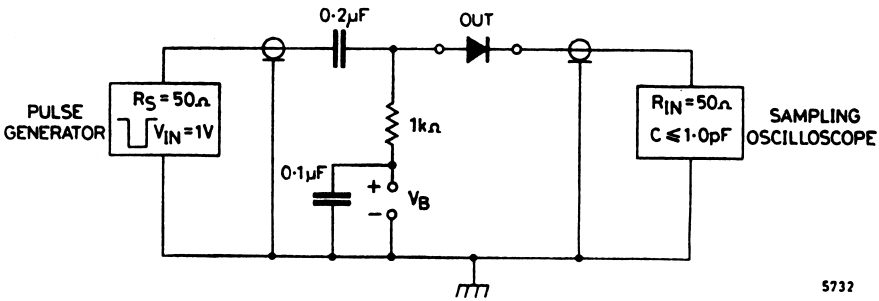
ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	BAL99	Unit
Continuous reverse voltage	V_R	70	V
Repetitive peak reverse voltage	V_{RRM}	70	V
Average rectified forward current (over any 20ms period)	$I_{F(AV)}$	100	mA
Repetitive peak forward current	I_{FRM}	200	mA

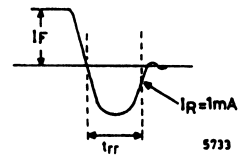
CHARACTERISTICS (at $T_j = 25°C$ unless otherwise specified).

Parameter	Symbol	Max.	Unit	Test conditions
Forward voltage	V_F	715 855 1.1 1.3	mV mV V V	$I_F = 1mA$ $I_F = 10mA$ $I_F = 50mA$ $I_F = 100mA$
Reverse current	I_R	30 2.5 50	μA μA μA	$V_R = 25V$, $T_j = 150°C$ $V_R = 70V$ $V_R = 70V$, $T_j = 150°C$
Diode capacitance	C_d	1.5	pF	$V_R = 0$, $f = 1MHz$
Forward recovery voltage	V_{fr}	1.75	V	Switched to $I_F = 10mA$, $t_r = 20ns$
Reverse recovery time	t_{rr}	6	ns	Switched from $I_F = 10mA$ to $V_R = 1V$ $R_L = 100\Omega$, $I_R = 1mA$

Circuit for measuring switching time



Output waveform



Pulse rise time ⩽ 0.6ns
Pulse duration = 100ns
Oscilloscope rise time ⩽ 0.35ns
Adjust V_B for I_F = 10mA

PIN CONFIGURATION

Devices are identified by a code on the body of the device

BAL99 . . . . . E2

High speed switching diode

BAR74

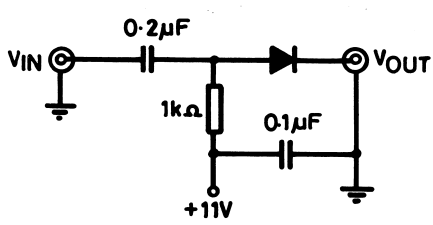
ABSOLUTE MAXIMUM RATINGS

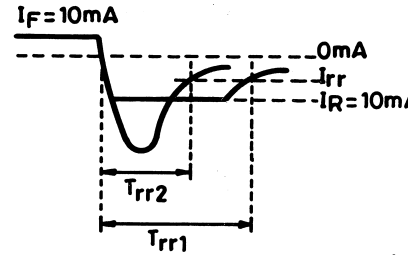
Parameter	Symbol	BAR74	Unit
Continuous reverse voltage	V_R	50	V
Average output rectified current (t_{AV}=10ms)	I_o	100	mA
Continuous forward current	I_F	150	mA
Peak forward current (t=15ms)	I_{FM}	200	mA
Forward surge current (t=1μs)	I_{FS}	1	A

CHARACTERISTICS (at T_{amb}=25°C unless otherwise specified).

Parameter	Symbol	Min.	Max.	Unit	Test conditions
Breakdown voltage	V_{BR}	51	–	V	I_R=5μA
Forward voltage	V_F	–	1.0	V	I_F=100mA
Reverse current	I_R	– –	0.1 100	μA μA	V_R=50V V_R=50V, T_{amb}=125°C
Capacitance	C_o	–	2.0	pF	V_R=0
Reverse recovery time	t_{rr}	– –	4 2	ns ns	I_F=I_R=10mA, I_{rr}=1mA I_F=10mA, V_R=6V, R_L=100Ω

Circuit for measuring switching time





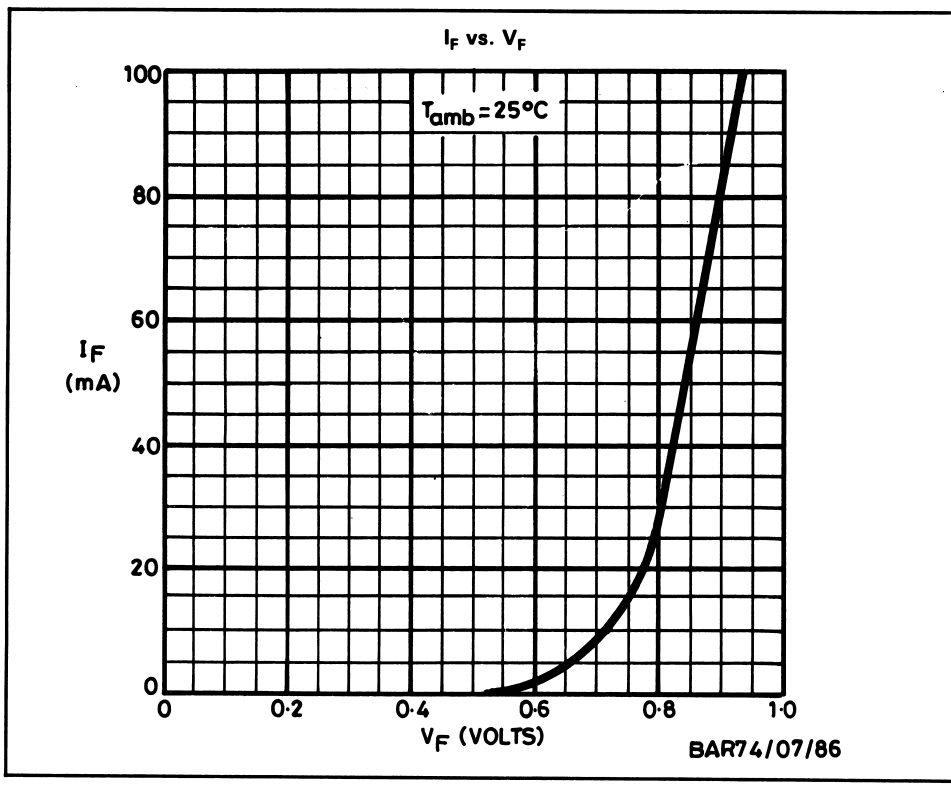
BAR74/07/86

Pulse is supplied by a generator with the following characteristics:

Output impedance = 50Ω
Rise time ⩽0.5ns
Pulse width = 100ns

Output is monitored on a sampling oscilloscope with the following characteristics:

Rise time ⩽0.6ns
Input impedance = 50Ω



PIN CONFIGURATION

BAR74/07/86

Devices are identified by a code on the body of the device

BAR74 . . . . . JB

High speed switching diode

BAR99

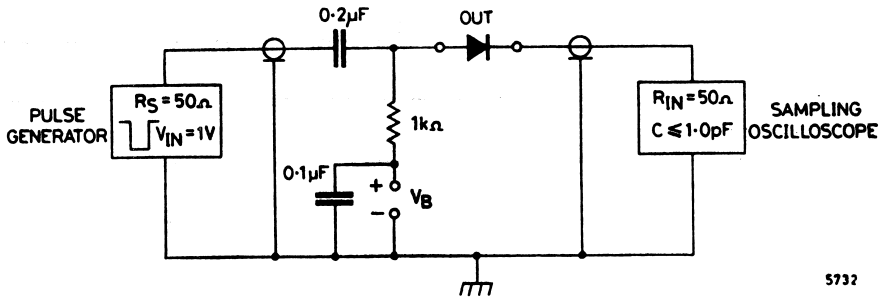
ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	BAR99	Unit
Continuous reverse voltage	V_R	70	V
Repetitive peak reverse voltage	V_{RRM}	70	V
Average rectified forward current (over any 20ms period)	$I_{F(AV)}$	100	mA
Repetitive peak forward current	I_{FRM}	200	mA

CHARACTERISTICS (at $T_j = 25°C$ unless otherwise specified).

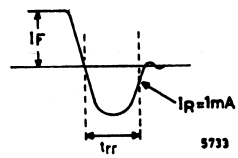
Parameter	Symbol	Max.	Unit	Test conditions
Forward voltage	V_F	715 855 1.1 1.3	mV mV V V	$I_F = 1mA$ $I_F = 10mA$ $I_F = 50mA$ $I_F = 100mA$
Reverse current	I_R	30 2.5 50	μA μA μA	$V_R = 25V$, $T_j = 150°C$ $V_R = 70V$ $V_R = 70V$, $T_j = 150°C$
Diode capacitance	C_d	1.5	pF	$V_R = 0$, $f = 1\,MHz$
Forward recovery voltage	V_{fr}	1.75	V	Switched to $I_F = 10mA$, $t_r = 20ns$
Reverse recovery time	t_{rr}	6	ns	Switched from $I_F = 10mA$ to $V_R = 1V$ $R_L = 100\Omega$, $I_R = 1mA$

Circuit for measuring switching time



Pulse rise time ⩽ 0.6ns
Pulse duration = 100ns
Oscilloscope rise time ⩽0.35ns
Adjust V_B for I_F = 10mA

Output waveform



PIN CONFIGURATION

Devices are identified by a code on the body of the device

BAR99 . . . . . E3

High speed switching diode

BAS16

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Continuous reverse voltage	V_R	75	V
Repetitive peak reverse voltage	V_{RRM}	85	V
Repetitive peak forward current	I_{FRM}	250	mA

CHARACTERISTICS (at 25°C ambient temperature unless otherwise stated).

Parameter	Symbol	Maximum	Unit	Conditions
Forward voltage	V_F	715	mV	$I_F = 1\,mA$
		855	mV	$I_F = 10\,mA$
		1000	mV	$I_F = 50\,mA$
		1250	mV	$I_F = 150\,mA$
Reverse current	I_R	30	μA	$V_R = 25V$, $T_j = 150°C$
		1	μA	$V_R = 75V$
		50	μA	$V_R = 75V$, $T_j = 150°C$
Diode capacitance	C_d	2	pF	$V_R = 0$, $f = 1\,MHz$
Forward recovery voltage	V_{fr}	1.75	V	Switched to $I_F = 10\,mA$, $t_r = 20\,ns$
Reverse recovery time	t_{rr}	6	ns	$I_F = 10\,mA$, $I_{RM} = 10\,mA$, $I_{rr} = 1\,mA$ $R_L = 100\Omega$

PIN CONFIGURATION

6175

Devices are identified by a code on the body of the device

BAS16 . . . . . A3

High speed switching diode

BAS19
BAS20
BAS21

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	BAS19	BAS20	BAS21	Unit
Continuous reverse voltage	V_R	100	150	200	V
Repetitive peak reverse voltage	V_{RRM}	120	200	250	V
Average rectified forward current (20ms period)	$I_{F(AV)}$	200			mA
Forward current	I_F	200			mA
Repetitive peak forward current	I_{FRM}	625			mA

CHARACTERISTICS (at $T_{amb}=25°C$ unless otherwise specified).

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test conditions
Reverse breakdown voltage	$V_{(BR)}$					
BAS19		120	–	–	V	$I_R=100\mu A$ (1)
BAS20		200	–	–	V	$I_R=100\mu A$ (1)
BAS21		250	–	–	V	$I_R=100\mu A$ (2)
Reverse current	I_R	–	–	100	nA	$V_R=V_{R\,max}$
		–	–	100	μA	$V_R=V_{R\,max}$, $T_j=150°C$
Static forward voltage	V_F	–	–	1.0	V	$I_F=100mA$
		–	–	1.25	V	$I_F=200mA$
Differential resistance	r_{diff}	–	5	–	Ω	$I_F=10mA$
Diode capacitance	C_d	–	–	5	pF	$V_R=0V$, f=1MHz
Reverse recovery time (Ref. Figs. 1 and 2)	t_{rr}	–	–	50	ns	$I_F=30mA$ to $I_R=30mA$ $R_L=100\Omega$ measured at $I_R=3mA$

(1) Measured under pulse conditions: Pulse width=300μs. Duty cycle ⩽2%.

(2) At zero life time, measured under pulse conditions to avoid excessive dissipation and voltage limited to 275V

SWITCHING TIME TEST DATA

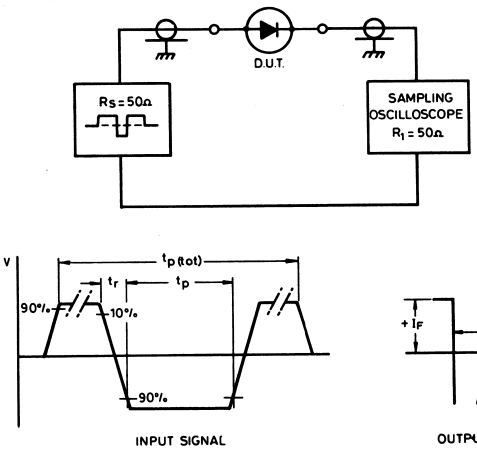


Fig. 1 Recovery time equivalent test circuit

Input signal

total pulse duration	$t_{p(tot)}$	= 2μs
duty factor	δ	= 0,0025
rise time of reverse pulse	t_r	= 0,6ns
reverse pulse duration	t_p	=100ns

Oscilloscope

rise time	t_r	= 0,35ns
circuit capacitance*	C	< 1pF

*C = oscilloscope input capacitance + parasitic capacitance.

PIN CONFIGURATION

BAS19/06/86

Devices are identified by a code on the body of the device

BAS19	A8
BAS20	A81
BAS21	A82

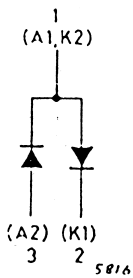
Dual schottky barrier diodes

BAS70-04
BAS70-05
BAS70-06

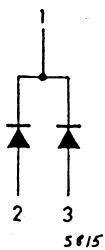
ELECTRICAL CHARACTERISTICS (at $T_{amb} = 25°C$ unless otherwise stated)

Parameter	Symbol	Min.	Max.	Unit	Test Conditions
Breakdown voltage	V_{BR}	70	—	V	$I_R = 10\mu A$
Reverse leakage current	I_R	—	200	nA	$V_R = 50V$
Forward voltage	V_F	—	410	mV	$I_F = 1mA$
Forward current	I_F	15	—	mA	$V_F = 1V$
Capacitance	C_T	—	2.0	pF	$V_R = 0V$, f = 1MHz
Effective minority lifetime	τ	—	100	ps	Refer to ZC2800E data sheet for test diagram

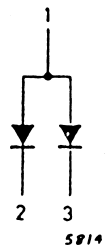
PIN CONFIGURATIONS



BAS70-04
(series pair)



BAS70-05
(common cathode)



BAS70-06
(common anode)

Devices are identified by a code on the body of the device:

BAS70-04 . . . . . 2Z
BAS70-05 . . . . . 2Z5
BAS70-06 . . . . . 1Z

High speed switching diode pair common cathode

BAV70

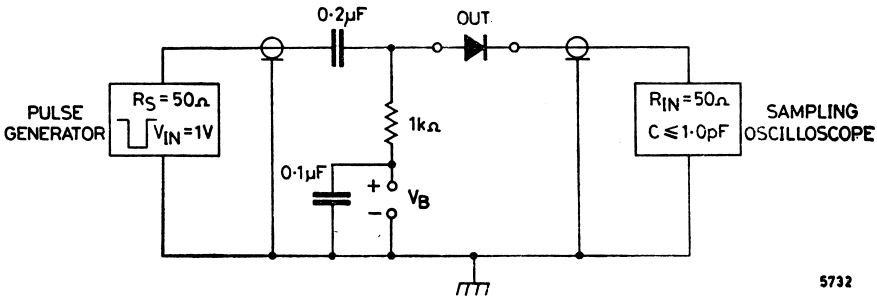
ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	BAV70	Unit
Continuous reverse voltage	V_R	70	V
Repetitive peak reverse voltage	V_{RRM}	70	V
Average rectified forward current (over any 20ms period)	$I_{F(AV)}$	100	mA
Repetitive peak forward current	I_{FRM}	200	mA

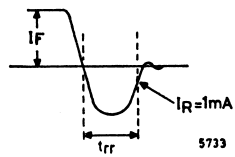
CHARACTERISTICS (at $T_j = 25°C$ unless otherwise specified).

Parameter	Symbol	Max.	Unit	Test conditions
Forward voltage	V_F	715 855 1.1 1.3	mV mV V V	$I_F = 1mA$ $I_F = 10mA$ $I_F = 50mA$ $I_F = 100mA$
Reverse current	I_R	60 5.0 100	μA μA μA	$V_R = 25V$, $T_j = 150°C$ $V_R = 70V$ $V_R = 70V$, $T_j = 150°C$
Diode capacitance	C_d	1.5	pF	$V_R = 0$, $f = 1MHz$
Forward recovery voltage	V_{fr}	1.75	V	Switched to $I_F = 10mA$, $t_r = 20ns$
Reverse recovery time	t_{rr}	6	ns	Switched from $I_F = 10mA$ to $V_R = 1V$ $R_L = 100Ω$, $I_R = 1mA$

Circuit for measuring switching time

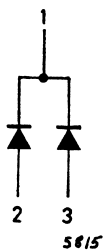


Output waveform



Pulse rise time ⩽ 0.6ns
Pulse duration = 100ns
Oscilloscope rise time ⩽0.35ns
Adjust V_B for I_F = 10mA

PIN CONFIGURATION



Devices are identified by a code on the body of the device

BAV70 . . . . . A4

High speed switching diode pair common cathode

BAV74

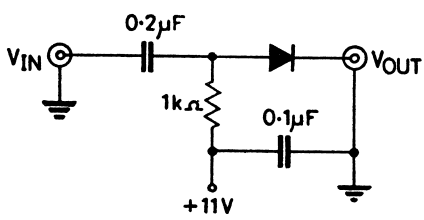
ABSOLUTE MAXIMUM RATINGS

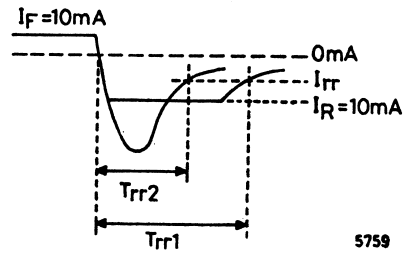
Parameter	Symbol	BAV74	Unit
Continuous reverse voltage	V_R	50	V
Average output rectified current (t_{AV}=10ms)	I_o	100	mA
Continuous forward current	I_F	150	mA
Peak forward current (t=15ms)	I_{FM}	200	mA
Forward surge current (t=1μs)	I_{FS}	1	A

CHARACTERISTICS (at T_j=25°C unless otherwise specified).

Parameter	Symbol	Min.	Max.	Unit	Test conditions
Breakdown voltage	V_{BR}	51	–	V	I_R=5μA
Forward voltage	V_F	–	1.0	V	I_F=100mA
Reverse current	I_R	– –	0.1 100	μA μA	V_R=50V V_R=50V, T_{amb}=125°C
Capacitance	C_o	–	2.0	pF	V_R=0
Reverse recovery time	t_{rr}	– –	4 2	ns ns	I_F=I_R=10mA, I_{rr}=1mA I_F=10mA, V_R=6V, R_L=100Ω

Circuit for measuring switching time





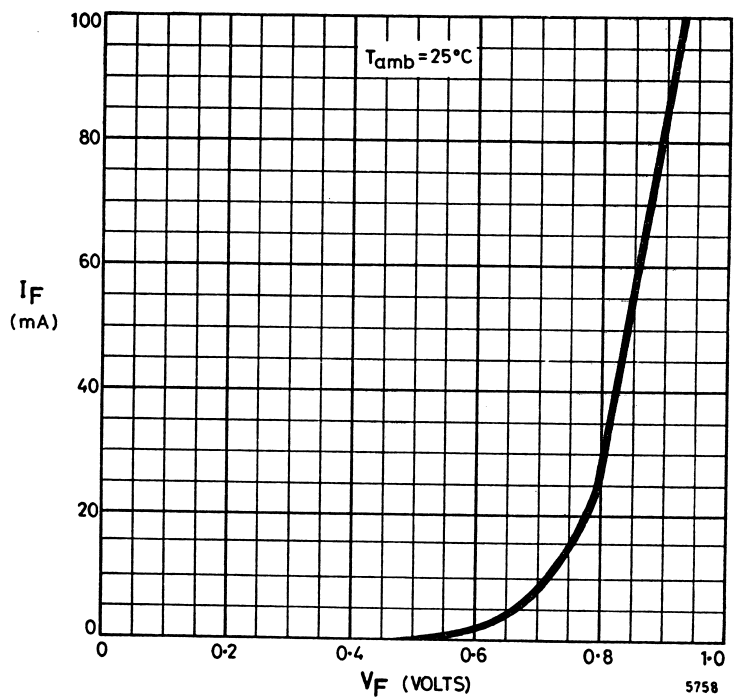
Pulse is supplied by a generator with the following characteristics:

Output impedance = 50Ω
Rise time ⩽0.5ns
Pulse width = 100ns

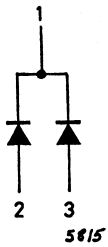
Output is monitored on a sampling oscilloscope with the following characteristics:

Rise time ⩽0.6ns
Input impedance = 50Ω

I_F vs. V_F



PIN CONFIGURATION



Devices are identified by a code on the body of the device

BAV74 . . . . . JA

High speed switching series diode pair

BAV99

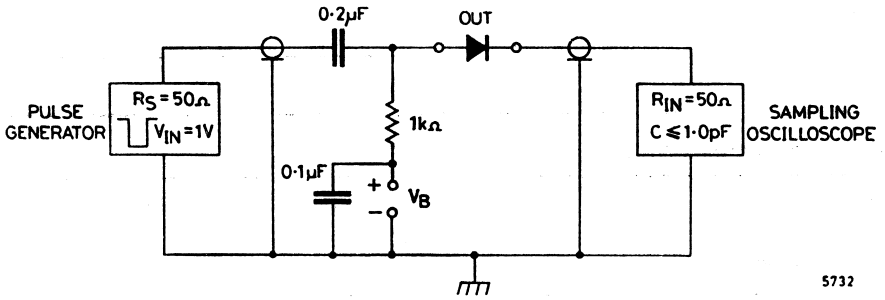
ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	BAV99	Unit
Continuous reverse voltage	V_R	70	V
Repetitive peak reverse voltage	V_{RRM}	70	V
Average rectified forward current (over any 20ms period)	$I_{F(AV)}$	100	mA
Repetitive peak forward current	I_{FRM}	200	mA

CHARACTERISTICS (at $T_j = 25°C$ unless otherwise specified).

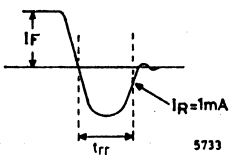
Parameter	Symbol	Max.	Unit	Test conditions
Forward voltage	V_F	715 855 1.1 1.3	mV mV V V	$I_F = 1mA$ $I_F = 10mA$ $I_F = 50mA$ $I_F = 100mA$
Reverse current	I_R	30 2.5 50	μA μA μA	$V_R = 25V$, $T_j = 150°C$ $V_R = 70V$ $V_R = 70V$, $T_j = 150°C$
Diode capacitance	C_d	1.5	pF	$V_R = 0$, $f = 1 MHz$
Forward recovery voltage	V_{fr}	1.75	V	Switched to $I_F = 10mA$, $t_r = 20ns$
Reverse recovery time	t_{rr}	6	ns	Switched from $I_F = 10mA$ to $V_R = 1V$ $R_L = 100\Omega$, $I_R = 1mA$

Circuit for measuring switching time

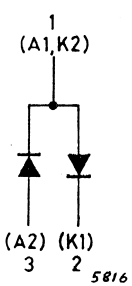


Pulse rise time ⩽ 0.6ns
Pulse duration = 100ns
Oscilloscope rise time ⩽0.35ns
Adjust V_B for I_F=10mA

Output waveform



PIN CONFIGURATION



Devices are identified by a code on the body of the device

BAV99 . . . . . A7

High speed switching diode pair (common anode)

BAW56

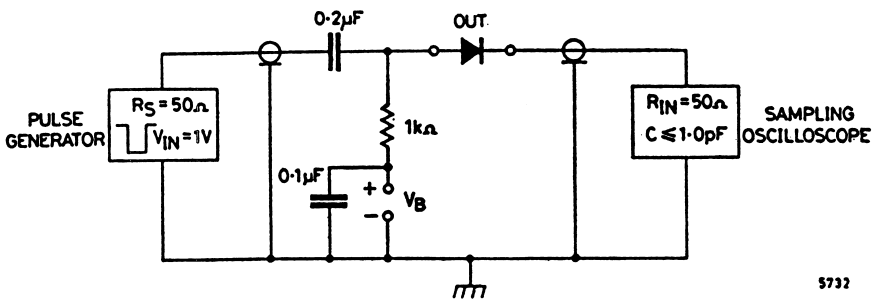
ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	BAW56	Unit
Continuous reverse voltage	V_R	70	V
Repetitive peak reverse voltage	V_{RRM}	70	V
Average rectified forward current (over any 20ms period)	$I_{F(AV)}$	100	mA
Repetitive peak forward current	I_{FRM}	200	mA

CHARACTERISTICS (at $T_j = 25°C$ unless otherwise specified).

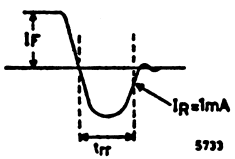
Parameter	Symbol	Max.	Unit	Test conditions
Forward voltage	V_F	715 855 1.1 1.3	mV mV V V	$I_F = 1mA$ $I_F = 10mA$ $I_F = 50mA$ $I_F = 100mA$
Reverse current	I_R	30 2.5 50	μA μA μA	$V_R = 25V$, $T_j = 150°C$ $V_R = 70V$ $V_R = 70V$, $T_j = 150°C$
Diode capacitance	C_d	2	pF	$V_R = 0$, f = 1 MHz
Forward recovery voltage	V_{fr}	1.75	V	Switched to $I_F = 10mA$, $t_r = 20ns$
Reverse recovery time	t_{rr}	6	ns	Switched from $I_F = 10mA$ to $V_R = 1V$ $R_L = 100\Omega$, $I_R = 1mA$

Circuit for measuring switching time

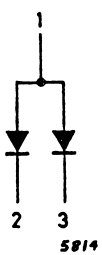


Pulse rise time ⩽ 0.6ns
Pulse duration = 100ns
Oscilloscope rise time ⩽0.35ns
Adjust V_B for I_F = 10mA

Output waveform



PIN CONFIGURATION



Devices are identified by a code on the body of the device

BAW56 . . . . . A1

Silicon variable capacitance diode

BBY31

ELECTRICAL CHARACTERISTICS (at $T_{amb}=25°C$ unless otherwise stated)

Characteristic	Symbol	Value			Units	Conditions
		Min.	Typ.	Max.		
Reverse breakdown voltage	V_{BR}	28	—	—	V	$I_R=10\mu A$
Reverse leakage current	I_R	— —	— —	0.05 1.0	μA μA	$V_R=28V$ $V_R=28V$, TA=85°C

TUNING CHARACTERISTICS (at $T_{amb}=25°C$ ambient temperature).

Characteristic	Symbol	Value			Units	Conditions
		Min.	Typ.	Max.		
Diode capacitance	C_d	— — 1.8	17.5 11.5 —	— — 2.8	pF pF pF	$V_R=1V$, f-1MHz $V_R=3V$, f=1 MHz $V_R=25V$, f=1 MHz
Capacitance ratio	C_d/C_d	—	5.0	—	—	3V/25V, f=1 MHz
Series resistance	r_D	—	—	1.2	Ω	f=470MHz at that value of V_R at which $C_d=9pF$

PIN CONFIGURATION

Devices are identified by a code on the body of the device

BBY31 . . . . . S1

Silicon variable capacitance diode

BBY40

ELECTRICAL CHARACTERISTICS (at $T_{amb}=25°C$ unless otherwise stated)

Characteristic	Symbol	Value			Units	Conditions
		Min.	Typ.	Max.		
Reverse breakdown voltage	V_{BR}	28	—	—	V	$I_R=10\mu A$
Reverse leakage current	I_R	— —	— —	0.05 1.0	μA μA	$V_R=28V$ $V_R=28V$, TA=60°C

TUNING CHARACTERISTICS (at $T_{amb}=25°C$ ambient temperature).

Characteristic	Symbol	Value			Units	Conditions
		Min.	Typ.	Max.		
Diode capacitance	C_d	26 4.3	— —	32 6.0	pF pF	$V_R=3V$, f-1MHz $V_R=25V$, f=1 MHz
Capacitance ratio	C_d/C_d	5.0	—	6.5	—	3V/25V, f=1 MHz
Series resistance	r_D	—	0.4	0.6	Ω	f=200 MHz at that value of V_R at which $C_d=25pF$

PIN CONFIGURATION

Devices are identified by a code on the body of the device

BBY40 . . . . . S2

NPN silicon planar general purpose transistors

BC846 BC847 BC848 BC849 BC850

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	BC846	BC847	BC848	BC849	BC850	Unit
Collector-base voltage	V_{CBO}	80	50	30	30	50	V
Collector-emitter voltage	V_{CES}	80	50	30	30	50	V
Collector-emitter voltage	V_{CEO}	65	45	30	30	45	V
Emitter-base voltage	V_{EBO}	6	6	5	5	5	V
Collector current	I_C	100	100	100	100	100	mA
Collector current (peak)	I_{CM}	200	200	200	200	200	mA
Base current (peak)	I_{BM}	200	200	200	200	200	mA
Emitter current (peak)	$-I_{EM}$	200	200	200	200	200	mA

CHARACTERISTICS (at $T_{amb}=25°C$ unless otherwise stated).

Parameter	Symbol		BC846	BC847	BC848	BC849	BC850	Unit	Conditions
Collector cut-off current	I_{CBO}	Max.	15	15	15	15	15	nA	$V_{CB}=30V$
		Max.	5	5	5	5	5	μA	$V_{CB}=30V$, $T_{amb}=150°C$
Collector-emitter saturation voltage	$V_{CE(sat)}$	Typ.	90	90	90	90	90	mV	$I_C=10mA$, $I_B=0.5mA$
		Max.	250	250	250	250	250	mV	
		Typ.	200	200	200	200	200	mV	$I_C=100mA$, $I_B=5mA$
		Max.	600	600	600	600	600	mV	
		Typ.	300	300	300	300	300	mV	$I_C=10mA$*
		Max.	600	600	600	600	600	mV	
Base-emitter saturation voltage	$V_{BE(sat)}$	Typ.	700	700	700	700	700	mV	$I_C=10mA$, $I_B=0.5mA$
		Typ.	900	900	900	900	900	mV	$I_C=100mA$, $I_B=5mA$
Base-emitter voltage	V_{BE}	Min.	580	580	580	580	580	mV	$I_C=2mA$, $V_{CE}=5V$
		Typ.	660	660	660	660	660	mV	
		Max.	700	700	700	700	700	mV	
		Max.	770	770	770	770	770	mV	$I_C=10mA$, $V_{CE}=5V$

*Collector-emitter saturation voltage at $I_C=10mA$ for the characteristics going through the operating point $I_C=11mA$, $V_{CE}=1V$ at constant base current.

CHARACTERISTICS (at $T_{amb}=25°C$ unless otherwise stated).

Parameter		Symbol		BC846	BC847	BC848	BC849	BC850	Unit	Conditions
Static forward current transfer ratio	Group VI	h_{FE}	Min. Typ. Max.	75 110 150	75 110 150	75 110 150	– – –	– – –		$I_C=2mA$ $V_{CE}=5V$
	Group A		Typ.	90	90	90	–	–		$I_C=0.01mA$ $V_{CE}=5V$
			Min. Typ. Max.	110 180 220	110 180 220	110 180 220				$I_C=2mA$ $V_{CE}=5V$
			Typ.	120	120	120	–	–		$I_C=100mA$ $V_{CE}=5V$
	Group B		Typ.	150	150	150	150	150		$I_C=0.01mA$ $V_{CE}=5V$
			Min. Typ. Max.	200 290 450	200 290 450	200 290 450	200 290 450	200 290 450		$I_C=2mA$ $V_{CE}=5V$
			Typ.	200	200	200	–	–		$I_C=100mA$ $V_{CE}=5V$
	Group C		Typ.	–	270	270	270	270		$I_C=0.01mA$ $V_{CE}=5V$
			Min. Typ. Max.	– – –	420 500 800	420 500 800	420 500 800	420 500 800		$I_C=2mA$ $V_{CE}=5V$
			Typ.	–	–	400	–	–		$I_C=100mA$ $V_{CE}=5V$
Transition frequency		f_T	Typ.	300	300	300	300	300	MHz	$I_C=10mA$ $V_{CE}=5V$ $f=100MHz$
Collector-base capacitance		C_{obo}	Typ. Max.	2.5 4.5	2.5 4.5	2.5 4.5	2.5 4.5	2.5 4.5	pF pF	$V_{CB}=10V$ $f=1MHz$

CHARACTERISTICS (cont.).

Parameter		Symbol		BC846	BC847	BC848	BC849	BC850	Unit	Conditions
Emitter-base capacitance		C_{ibo}	Typ.	9	9	9	9	9	pF	$V_{EB}=0.5V$ f=1MHz
Noise figure		N	Typ.	2	2	2	1.2	1	dB	$V_{CE}=5V$ $I_C=200\mu A$ $R_G=2k\Omega$ f=1kHz $\Delta f=200Hz$
			Max.	10	10	10	4	4	dB	
			Typ.	–	–	–	1.4	1.4	dB	$V_{CE}=5V$ $I_C=200\mu A$ $R_G=2k\Omega$ f=30Hz to 15kHz at −3dB points
			Max.	–	–	–	4	3	dB	
Equivalent noise voltage		e_n	Max.	–	–	–	135	135	nV	$V_{CE}=5V$ $I_C=200\mu A$ $R_G=2k\Omega$ f=10 to 50Hz at −3dB points
Dynamic characteristics	Group VI	h_{ie}	Min.	0.4	0.4	0.4	–	–	kΩ	$V_{CE}=5V$ $I_C=2mA$ f=1kHz
			Typ.	1.2	1.2	1.2	–	–	kΩ	
			Max.	2.2	2.2	2.2	–	–	kΩ	
	Group A		Min.	1.6	1.6	1.6			kΩ	
			Typ.	2.7	2.7	2.7			kΩ	
			Max.	4.5	4.5	4.5			kΩ	
	Group B		Min.	3.2	3.2	3.2	3.2	3.2	kΩ	
			Typ.	4.5	4.5	4.5	4.5	4.5	kΩ	
			Max.	8.5	8.5	8.5	8.5	8.5	kΩ	
	Group C		Min.	–	–	6	6	6	kΩ	
			Typ.	–	–	8.7	8.7	8.7	kΩ	
			Max.	–	–	15	15	15	kΩ	
	Group VI	h_{re}	Typ.	2.5	2.5	2.5	–	–	$x10^{-4}$	
	Group A		Typ.	1.5	1.5	1.5			$x10^{-4}$	
	Group B		Typ.	2	2	2	2	2	$x10^{-4}$	
	Group C		Typ.	–	–	3	3	3	$x10^{-4}$	
	Group VI	h_{fe}	Min.	75	75	75	–	–		
			Typ.	110	110	110	–	–		
			Max.	150	150	150	–	–		
	Group A		Min.	125	125	125				
			Typ.	220	220	220				
			Max.	260	260	260				
	Group B		Min.	240	240	240	240	240		
			Typ.	330	330	330	330	330		
			Max.	500	500	500	500	500		
	Group C		Min.	–	450	450	450	450		
			Typ.	–	600	600	600	600		
			Max.	–	900	900	900	900		
	Group VI	h_{oe}	Typ.	20	20	20	–	–	μS	
			Max.	40	40	40	–	–	μS	
	Group A		Typ.	18	18	18			μS	
			Max.	30	30	30			μS	
	Group B		Typ.	30	30	30	30	30	μS	
			Max.	60	60	60	60	60	μS	
	Group C		Typ.	–	–	60	60	60	μS	
			Max.	–	–	110	110	110	μS	

Devices are identified by a code on the body of the device

BC846A	1A
BC846B	1B
BC847A	1E
BC847B	1F
BC847C	1G
BC848A	1J
BC848B	1K
BC848C	1L
BC849B	2B
BC849C	2C
BC850B	2F
BC850C	2G

PNP silicon planar general purpose transistors

BC856 BC857 BC858 BC859 BC860

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	BC856	BC857	BC858	BC859	BC860	Unit
Collector-base voltage	V_{CBO}	−80	−50	−30	−30	−50	V
Collector-emitter voltage	V_{CES}	−80	−50	−30	−30	−50	V
Collector-emitter voltage	V_{CEO}	−65	−45	−30	−30	−45	V
Emitter-base voltage	V_{EBO}	−5	−5	−5	−5	−5	V
Collector current	I_C	−100	−100	−100	−100	−100	mA
Collector current (peak)	I_{CM}	−200	−200	−200	−200	−200	mA
Base current (peak)	I_{BM}	−200	−200	−200	−200	−200	mA
Emitter current (peak)	$-I_{EM}$	−200	−200	−200	−200	−200	mA

CHARACTERISTICS (at $T_{amb} = 25°C$ unless otherwise stated).

Parameter	Symbol		BC856	BC857	BC858	BC859	BC860	Unit	Conditions
Collector cut-off current	I_{CBO}	Max. Max.	−15 −4	−15 −4	−15 −4	−15 −4	−15 −4	nA μA	$V_{CB} = -30V$ $V_{CB} = -30V$ $T_{amb} = 150°C$
Collector-emitter saturation voltage	$V_{CE(sat)}$	Typ. Max.	−75 −300	−75 −300	−75 −3000	−75 −250	−75 −250	mV mV	$I_C = -10mA$ $I_B = -0.5mA$
		Typ. Max.	−250 −650	−250 −650	−250 −650	−250 −650	−250 −650	mV mV	$I_C = -100mA$ $I_B = -5mA$
		Typ. Max.	−300 −600	−300 −600	−300 −600	−300 −600	−300 −600	mV mV	$I_C = -10mA$*
Base-emitter saturation voltage	$V_{BE(sat)}$	Typ. Typ.	−700 −850	−700 −850	−700 −850	−700 −850	−700 −850	mV mV	$I_C = -10mA$ $I_B = -0.5mA$ $I_C = -100mA$ $I_B = -5mA$
Base-emitter voltage	V_{BE}	Min. Typ. Max.	−600 −650 −750	−600 −650 −750	−600 −650 −750	−580 −650 −750	−580 −650 −750	mV mV mV	$I_C = -2mA$ $V_{CE} = -5V$
		Max.	−820	−820	−820	−820	−820	mV	$I_C = -10mA$ $V_{CE} = -5V$

*Collector-emitter saturation voltage at $I_C = 10mA$ for the characteristics going through the operating point $I_C = 11mA$, $V_{CE} = 1V$ at constant base current.

CHARACTERISTICS (at $T_{amb}=25°C$ unless otherwise stated).

Parameter		Symbol		BC856	BC857	BC858	BC859	BC860	Unit	Conditions
Static forward current transfer ratio	Group VI	h_{FE}	Min.	75	75	75	–	–		$I_C=-2mA$, $V_{CE}=-5V$
			Typ.	110	110	110	–	–		
			Max.	150	150	150	–	–		
	Group A		Typ.	90	90	90	–	–		$I_C=-0.01mA$, $V_{CE}=-5V$
			Min.	125	125	125	125	125		$I_C=-2mA$, $V_{CE}=-5V$
			Typ.	180	180	180	180	180		
			Max.	250	250	250	250	250		
			Typ.	120	120	120	–	–		$I_C=-100mA$, $V_{CE}=-5V$
	Group B		Typ.	150	150	150	150	150		$I_C=-0.01mA$, $V_{CE}=-5V$
			Min.	220	220	220	220	220		$I_C=-2mA$, $V_{CE}=-5V$
			Typ.	290	290	290	290	290		
			Max.	475	475	475	475	475		
			Typ.	200	200	200	–	–		$I_C=-100mA$, $V_{CE}=-5V$
	Group C		Typ.	–	270	270	270	270		$I_C=-0.01mA$, $V_{CE}=-5V$
			Min.	–	420	420	420	420		$I_C=-2mA$, $V_{CE}=-5V$
			Typ.	–	500	500	500	500		
			Max.	–	800	800	800	800		
			Typ.	–	–	400	–	–		$I_C=-100mA$, $V_{CE}=-5V$
Transition frequency		f_T	Typ.	150	150	150	300	300	MHz	$I_C=-10mA$, $V_{CE}=-5V$, $f=100MHz$
Collector-base capacitance		C_{obo}	Typ.	4.5	4.5	4.5	4.5	4.5	pF	$V_{CB}=-10V$, $f=1MHz$

CHARACTERISTICS (cont.).

Parameter	Symbol		BC856	BC857	BC858	BC859	BC860	Unit	Conditions
Noise figure	N	Typ.	2	2	2	1	1	dB	$V_{CE}=-5V$ $I_C=-200\mu A$ $R_G=2k\Omega$ f=1kHz $\Delta f=200Hz$
		Max.	10	10	10	4	4	dB	
		Typ.	–	–	–	1.2	1	dB	$V_{CE}=-5V$ $I_C=-200\mu A$ $R_G=2k\Omega$ f=30Hz to 15kHz at −3dB points
		Max.	–	–	–	4	3	dB	
Equivalent noise voltage	e_n	Max.	–	–	–	−110	−110	nV	$V_{CE}=-5V$ $I_C=-200\mu A$ $R_G=2k\Omega$ f=10 to 50Hz at −3dB points
Dynamic characteristics Group VI	h_{ie}	Min.	0.4	0.4	0.4	–	–	kΩ	$V_{CE}=-5V$ $I_C=-2mA$ f=1kHz
		Typ.	1.2	1.2	1.2	–	–	kΩ	
		Max.	2.2	2.2	2.2	–	–	kΩ	
Group A		Min.	1.6	1.6	1.6	1.6	1.6	kΩ	
		Typ.	2.7	2.7	2.7	2.7	2.7	kΩ	
		Max.	4.5	4.5	4.5	4.5	4.5	kΩ	
Group B		Min.	3.2	3.2	3.2	3.2	3.2	kΩ	
		Typ.	4.5	4.5	4.5	4.5	4.5	kΩ	
		Max.	8.5	8.5	8.5	8.5	8.5	kΩ	
Group C		Min.	–	–	6	6	6	kΩ	
		Typ.	–	–	8.7	8.7	8.7	kΩ	
		Max.	–	–	15	15	15	kΩ	
Group VI	h_{re}	Typ.	2.5	2.5	2.5	–	–	$\times10^{-4}$	
Group A		Typ.	1.5	1.5	1.5	1.5	1.5	$\times10^{-4}$	
Group B		Typ.	2	2	2	2	2	$\times10^{-4}$	
Group C		Typ.	–	–	3	3	3	$\times10^{-4}$	
Group VI	h_{fe}	Min.	75	75	75	–	–		
		Typ.	110	110	110	–	–		
		Max.	150	150	150	–	–		
Group A		Min.	125	125	125	125	125		
		Typ.	220	220	220	220	220		
		Max.	260	260	260	260	260		
Group B		Min.	240	240	240	240	240		
		Typ.	330	330	330	330	330		
		Max.	500	500	500	500	500		
Group C		Min.	–	450	450	450	450		
		Typ.	–	600	600	600	600		
		Max.	–	900	900	900	900		
Group VI	h_{oe}	Typ.	20	20	20	–	–	μS	
		Max.	40	40	40	–	–	μS	
Group A		Typ.	18	18	18	18	18	μS	
		Max.	30	30	30	30	30	μS	
Group B		Typ.	30	30	30	30	30	μS	
		Max.	60	60	60	60	60	μS	
Group C		Typ.	–	–	60	60	60	μS	
		Max.	–	–	110	110	110	μS	

Devices are identified by a code on the body of the device

BC856A	3A
BC856B	3B
BC857A	3E
BC857B	3F
BC857C	3G
BC858A	3J
BC858B	3K
BC858C	3L
BC859A	4A
BC859B	4B
BC859C	4C
BC860A	4E
BC860B	4F
BC860C	4G

PNP silicon Darlington transistors

BCV26 BCV46

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	BCV26	BCV46	Unit
Collector-Base Voltage	V_{CBO}	−40	−80	V
Collector-Emitter Voltage	V_{CEO}	−30	−60	V
Emitter-Base Voltage	V_{EBO}	−10		V
Continuous Collector Current	I_C	−500		mA
Peak Collector Current	I_{CM}	−800		mA
Base Current	I_B	−100		mA
Peak Base Current	I_{BM}	−200		mA

ELECTRICAL CHARACTERISTICS (at $T_{amb} = 25°C$ unless otherwise stated).

Parameter	Symbol	BCV26			BCV46			Unit	Test Conditions
		Min.	Typ.	Max.	Min.	Typ.	Max.		
Collector-base breakdown voltage	$V_{(BR)CBO}$	−40	—	—	−80	—	—	V	$I_C = -100\mu A$, $I_E = 0$
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	−30	—	—	−60	—	—	V	$I_C = -10mA$, $I_B = 0$
Emitter-base breakdown voltage	$V_{(BR)EBO}$	−10	—	—	−10	—	—	V	$I_E = -10\mu A$, $I_C = 0$
Collector cut-off current	I_{CBO}	—	—	−100				nA	$V_{CB} = -30V$, $I_E = 0$
					—	—	−100	nA	$V_{CB} = -60V$, $I_E = 0$
		—	—	−10				μA	$V_{CB} = -30V$, $T_A = 150°C$
					—	—	−10	μA	$V_{CB} = -60V$, $T_A = 150°C$
Emitter cut-off current	I_{EBO}	—	—	−100	—	—	−100	nA	$V_{EB} = -4V$

ELECTRICAL CHARACTERISTICS (continued).

Parameter	Symbol	BCV26			BCV46			Unit	Test Conditions
		Min.	Typ.	Max.	Min.	Typ.	Max.		
Static forward current transfer ratio	h_{FE}*	4K	—	—	2K	—	—		$I_C = -100\mu A$ $V_{CE} = -1V$
		10K	—	—	4K	—	—		$I_C = -10mA$ $V_{CE} = -5V$
		20K	—	—	10K	—	—		$I_C = -100mA$ $V_{CE} = -5V$
		4K	—	—	2K	—	—		$I_C = -500mA$ $V_{CE} = -5V$
Collector-emitter saturation voltage	$V_{CE(sat)}$*	—	—	−1.0	—	—	−1.0	V	$I_C = -100mA$ $I_B = -0.1mA$
Collector-base saturation voltage	$V_{BE(sat)}$*	—	—	−1.5	—	—	−1.5	V	$I_C = -100mA$ $I_B = -0.1mA$
Transition frequency	f_T	—	200	—	—	200	—	MHz	$I_C = -50mA$ $V_{CE} = -5V$ f = 20MHz
Output capacitance	C_{obo}	—	4.5	—	—	4.5	—	pF	$V_{CB} = -10V$ f = 1 MHz

*Measured under pulsed conditions. Pulse width = 300μs. Duty cycle ⩽ 2%.

Devices are identified by a code on the body of the device.

BCV26 . . . . . ZFD
BCV46 . . . . . ZFE

NPN silicon Darlington transistors

BCV27 BCV47

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	BCV27	BCV47	Unit
Collector-Base Voltage	V_{CBO}	40	80	V
Collector-Emitter Voltage	V_{CEO}	30	60	V
Emitter-Base Voltage	V_{EBO}	10		V
Continuous Collector Current	I_C	500		mA
Peak Collector Current	I_{CM}	800		mA
Base Current	I_B	100		mA
Peak Base Current	I_{BM}	200		mA

ELECTRICAL CHARACTERISTICS (at $T_{amb} = 25°C$ unless otherwise stated).

Parameter	Symbol	BCV27			BCV47			Unit	Test Conditions
		Min.	Typ.	Max.	Min.	Typ.	Max.		
Collector-base breakdown voltage	$V_{(BR)CBO}$	40	–	–	80	–	–	V	$I_C = 100\mu A$, $I_E = 0$
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	30	–	–	60	–	–	V	$I_C = 10mA$, $I_B = 0$
Emitter-base breakdown voltage	$V_{(BR)EBO}$	10	–	–	10	–	–	V	$I_E = 10\mu A$, $I_C = 0$
Collector cut-off current	I_{CBO}	–	–	100				nA	$V_{CB} = 30V$, $I_E = 0$
					–	–	100	nA	$V_{CB} = 60V$, $I_E = 0$
		–	–	– 10				μA	$V_{CB} = 30V$, $T_A = 150°C$
					–	–	10	μA	$V_{CB} = 60V$, $T_A = 150°C$
Emitter cut-off current	I_{EBO}	–	–	100	–	–	100	nA	$V_{EB} = 4V$

ELECTRICAL CHARACTERISTICS (continued).

Parameter	Symbol	BCV27			BCV47			Unit	Test Conditions
		Min.	Typ.	Max.	Min.	Typ.	Max.		
Static forward current transfer ratio	h_{FE}*	4K 10K 20K 4K	— — — —	— — — —	2K 4K 10K 2K	— — — —	— — — —		$I_C = 100\mu A$, $V_{CE} = 1V$ $I_C = 10mA$, $V_{CE} = 5V$ $I_C = 100mA$, $V_{CE} = 5V$ $I_C = 500mA$, $V_{CE} = 5V$
Collector-emitter saturation voltage	$V_{CE(sat)}$*	—	—	1.0	—	—	1.0	V	$I_C = 100mA$ $I_B = 0.1mA$
Collector-base saturation voltage	$V_{BE(sat)}$*	—	—	1.5	—	—	1.5	V	$I_C = 100mA$ $I_B = 0.1mA$
Transition frequency	f_T	—	170	—	—	170	—	MHz	$I_C = 50mA$, $V_{CE} = 5V$ $f = 20MHz$
Output capacitance	C_{obo}	—	3.5	—	—	3.5	—	pF	$V_{CB} = 10V$ $f = 1MHz$

*Measured under pulsed conditions. Pulse width = 300μs. Duty cycle $\leqslant$ 2%.

Devices are identified by a code on the body of the device.

BCV27 . . . . . ZFF
BCV47 . . . . . ZFG

NPN silicon planar small signal transistors

BCV71
BCV72

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	BCV71 & BCV72	Unit
Collector Base Voltage	V_{CBO}	80	V
Collector-Emitter Voltage ($I_C = 2mA$)	V_{CEO}	60	V
Emitter-Base Voltage	V_{EBO}	5	V
Collector Current	I_C	100	mA
Peak Collector Current	I_{CM}	200	mA

CHARACTERISTICS (at $T_j = 25°C$ unless otherwise stated).

Parameter		Symbol	BCV71 & 72 Min.	BCV71 & 72 Typ.	BCV71 & 72 Max.	Unit	Conditions
Collector-base cut-off current		I_{CBO}	— —	— —	100 10	nA μA	$I_E = 0$, $V_{CB} = 20V$ $I_E = 0$, $V_{CB} = 20V$ $T_j = 100°C$
Base-emitter voltage		V_{BE}	550	—	750	mV	$I_C = 2mA$, $V_{CE} = 5V$
Collector-emitter saturation voltage		$V_{CE(sat)}$	— —	120 210	250 —	mV mV	$I_C = 10mA$, $I_B = 0.5mA$ $I_C = 50mA$, $I_B = 2.5mA$
Base-emitter saturation voltage		$V_{BE(sat)}$	— —	750 850	— —	mV mV	$I_C = 10mA$, $I_B = 0.5mA$ $I_C = 50mA$, $I_B = 2.5mA$
Static forward current transfer ratio	BCV71	h_{FE}	— 110	90 —	— 220		$I_C = 10\mu A$, $V_{CE} = 5V$ $I_C = 2mA$, $V_{CE} = 5V$
	BCV72	h_{FE}	— 200	150 —	— 450		$I_C = 10\mu A$, $V_{CE} = 5V$ $I_C = 2mA$, $V_{CE} = 5V$
Transition frequency		f_T	—	300	—	MHz	$I_C = 10mA$, $V_{CE} = 5V$ $f = 35MHz$
Collector capacitance		C_{Tc}	—	—	4	pF	$I_E = I_e = 0$, $V_{CB} = 10V$ $f = 1MHz$
Noise figure		N	—	—	10	dB	$I_C = 200\mu A$, $V_{CE} = 5V$ $R_s = 2k\Omega$, $f = 1kHz$ $B = 200Hz$

Devices are identified by a code on the body of the device

BCV71	K7
BCV72	K8
BCV71R	K6
BCV72R	K9

PNP silicon planar small signal transistors

BCW29
BCW30

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	BCW29 & BCW30	Unit
Collector-Base Voltage	V_{CBO}	−30	V
Collector-Emitter Voltage	V_{CES}	−30	V
Collector-Emitter Voltage ($-I_C = 2mA$)	V_{CEO}	−20	V
Emitter-Base Voltage	V_{EBO}	−5	V
Collector Current	I_C	−100	mA
Peak Collector Current	I_{CM}	−200	mA

CHARACTERISTICS (at $T_j = 25°C$ unless otherwise stated).

Parameter		Symbol	BCW29 & BCW30 Min.	Typ.	Max.	Unit	Conditions
Collector-base cut-off current		I_{CBO}	— —	— —	−100 −10	nA μA	$I_E = 0$, $V_{CB} = -20V$ $I_E = 0$, $V_{CB} = -20V$ $T_j = 100°C$
Base-emitter voltage		V_{BE}	−600	—	−750	mV	$I_C = -2.0mA$, $V_{CE} = -5V$
Collector-emitter saturation voltage		$V_{CE(sat)}$	— —	−80 −150	−300 —	mV mV	$I_C = -10mA$, $I_B = -0.5mA$ $I_C = -50mA$, $I_B = -2.5mA$
Base-emitter saturation voltage		$V_{BE(sat)}$	— —	−720 −810	— —	mV mV	$I_C = -10mA$, $I_B = -0.5mA$ $I_C = -50mA$, $I_B = -2.5mA$
Static forward current transfer ratio	BCW29	h_{FE}	— 120	90 —	— 260		$I_C = -10\mu A$, $V_{CE} = -5V$ $I_C = -2.0mA$, $V_{CE} = -5V$
	BCW30	h_{FE}	— 215	150 —	— 500		$I_C = -10\mu A$, $V_{CE} = -5V$ $I_C = -2.0mA$, $V_{CE} = -5V$
Transition frequency		f_T	—	150	—	MHz	$I_C = -10mA$, $V_{CE} = -5V$ $f = 35MHz$
Collector capacitance		C_{Tc}	—	—	7	pF	$I_E = I_e = 0$, $V_{CB} = -10V$ $f = 1MHz$
Noise figure		N	—	—	10	dB	$I_C = -200\mu A$, $V_{CE} = -5V$ $R_s = 2k\Omega$, $f = 1kHz$ $B = 200Hz$

Devices are identified by a code on the body of the device

BCW29	C1
BCW30	C2
BCW29R	C4
BCW30R	C5

NPN silicon planar small signal transistors

BCW31
BCW32
BCW33

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	BCW31, 32 & 33	Unit
Collector-Base Voltage	V_{CBO}	30	V
Collector-Emitter Voltage (I_C = 2.0mA)	V_{CEO}	20	V
Emitter-Base Voltage	V_{EBO}	5	V
Collector Current	I_C	100	mA
Peak Collector Current	I_{CM}	200	mA

CHARACTERISTICS (at T_j = 25°C unless otherwise stated).

Parameter		Symbol	BCW31, 32 & 33			Unit	Conditions
			Min.	Typ.	Max.		
Collector-base cut-off current		I_{CBO}	— —	— —	100 10	nA μA	I_E = 0, V_{CB} = 20V I_E = 0, V_{CB} = 20V T_j = 100°C
Base-emitter voltage		V_{BE}	550	—	700	mV	I_C = 2mA, V_{CE} = 5V
Collector-emitter saturation voltage		$V_{CE(sat)}$	— —	120 210	250 —	mV mV	I_C = 10mA, I_B = 0.5mA I_C = 50mA, I_B = 2.5mA
Base-emitter saturation voltage		$V_{BE(sat)}$	— —	750 850	— —	mV mV	I_C = 10mA, I_B = 0.5mA I_C = 50mA, I_B = 2.5mA
Static forward current transfer ratio	BCW31	h_{FE}	— 110	90 —	— 220		I_C = 10μA, V_{CE} = 5V I_C = 2mA, V_{CE} = 5V
	BCW32	h_{FE}	— 200	150 —	— 450		I_C = 10μA, V_{CE} = 5V I_C = 2mA, V_{CE} = 5V
	BCW33	h_{FE}	— 420	270 —	— 800		I_C = 10μA, V_{CE} = 5V I_C = 2mA, V_{CE} = 5V
Transition frequency		f_T	—	300	—	MHz	I_C = 10mA, V_{CE} = 5V f = 35MHz
Collector capacitance		C_{Tc}	—	—	4	pF	I_E = I_e = 0, V_{CB} = 10V f = 1MHz
Noise figure		N	—	—	10	dB	I_C = 200μA, V_{CE} = 5V R_s = 2kΩ, f = 1kHz B = 200Hz

Devices are identified by a code on the body of the device

BCW31	D1
BCW32	D2
BCW33	D3
BCW31R	D4
BCW32R	D5
BCW33R	D6

NPN silicon planar small signal transistor

BCW60

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	BCW60	Unit
Collector-Emitter Voltage	V_{CES}	32	V
Collector-Emitter Voltage	V_{CEO}	32	V
Emitter-Base Voltage	V_{EBO}	5	V
Collector Current	I_C	200	mA
Base Current	I_B	50	mA

CHARACTERISTICS (at 25°C unless otherwise stated).

Parameter		Symbol	Min.	Typ.	Max.	Unit	Test Conditions
Collector-emitter breakdown voltage		$V_{(BR)CEO}$	32	—	—	V	$I_{CEO}=2mA$
Emitter-base breakdown voltage		$V_{(BR)EBO}$	5	—	—	V	$I_{EBO}=1\mu A$
Collector-emitter cut-off current		I_{CES}	— —	— —	20 20	nA μA	$V_{CES}=32V$ $V_{CES}=32V$, $T_{amb}=150°C$
Emitter-base cut-off current		I_{EBO}	—	—	20	nA	$V_{EBO}=4V$
Collector-emitter saturation voltage		$V_{CE(sat)}$	— —	0.12 0.20	0.35 0.55	V V	$I_C=10mA$, $I_B=0.25mA$ $I_C=50mA$, $I_B=1.25mA$
Base-emitter saturation voltage		$V_{BE(sat)}$	0.60 0.70	0.70 0.83	0.85 1.05	V V	$I_C=10mA$, $I_B=0.25mA$ $I_C=50mA$, $I_B=1.25mA$
Base-emitter voltage		V_{BE}	— 0.55 —	0.52 0.65 0.78	— 0.75 —	V V V	I_C 10μA, $V_{CE}=5V$ $I_C=2mA$, $V_{CE}=5V$ $I_C=50mA$, $V_{CE}=1V$
Static forward current transfer ratio	BCW60A	h_{FE}	— 120 50	78 170 —	— 220 —		$I_C=10\mu A$, $V_{CE}=5V$ $I_C=2mA$, $V_{CE}=5V$ $I_C=50mA$, $V_{CE}=1V$
	BCW60B	h_{FE}	20 180 70	145 250 —	— 310 —		$I_C=10\mu A$, $V_{CE}=5V$ $I_C=2mA$, $V_{CE}=5V$ $I_C=50mA$, $V_{CE}=1V$
	BCW60C	h_{FE}	40 250 90	220 350 —	— 460 —		$I_C=10\mu A$, $V_{CE}=5V$ $I_C=2mA$, $V_{CE}=5V$ $I_C=50mA$, $V_{CE}=1V$
	BCW60D	h_{FE}	100 380 100	300 500 —	— 630 —		$I_C=10\mu A$, $V_{CE}=5V$ $I_C=2mA$, $V_{CE}=5V$ $I_C=50mA$, $V_{CE}=1V$

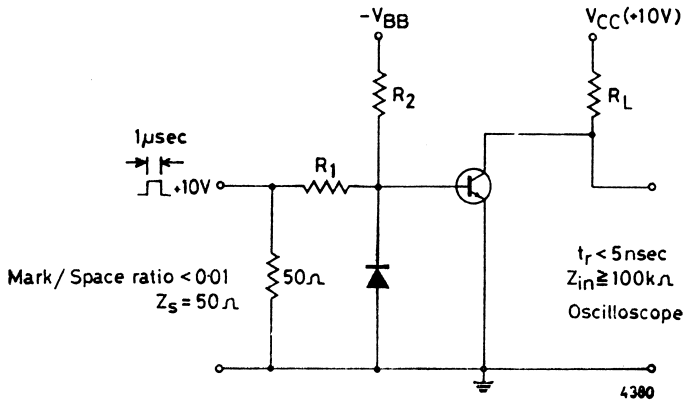
CHARACTERISTICS (continued).

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
Transition frequency	f_T	125	250	—	MHz	I_C = 10mA, V_{CE} = 5V f = 100MHz
Collector-base capacitance	C_{cbo}	—	—	4.5	pF	V_{CBO} = 10V, f = 1 MHz
Emitter-base capacitance	C_{ebo}	—	8	—	pF	V_{EBO} = 0.5V, f = 1 MHz
Noise figure	N	—	2	6	dB	I_C = 0.2mA, V_{CE} = 5V R_G = 2kΩ, f = 1 kHz △f = 200Hz
Switching times						
Delay time	t_d	—	35	—	ns	I_C:I_{B1}:−I_{B2} = 10:1:1mA R_1 = 5kΩ, R_2 = 5kΩ V_{BB} = 3.6V, R_L = 990Ω
Rise time	t_r	—	50	—	ns	
Turn-on time	t_{on}	—	85	150	ns	
Storage time	t_s	—	400	—	ns	
Fall time	t_f	—	80	—	ns	
Turn-off time	t_{off}	—	480	800	ns	

FOUR TERMINAL NETWORK DATA (I_C = 2mA, V_{CE} = 5V, f = 1 kHz).

	h_{FE} Group A			h_{FE} Group B			h_{FE} Group C			h_{FE} Group D			
	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
h_{11e}	1.6	2.7	4.5	2.5	3.6	6.0	3.2	4.5	8.5	4.5	7.5	12	K
h_{12e}	—	1.5	—	—	2	—	—	2	—	—	3	—	10^{-4}
h_{21e}	—	200	—	—	260	—	—	330	—	—	520	—	
h_{22e}	—	18	30	—	24	50	—	30	60	—	50	100	μs

SWITCHING CIRCUIT



Devices are identified by a code on the body of the device

BCW60A	AA
BCW60B	AB
BCW60C	AC
BCW60D	AD
BCW60AR	CR
BCW60BR	DR
BCW60CR	AR
BCW60DR	BR

PNP silicon planar small signal transistor

BCW61

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	BCW61	Unit
Collector-Emitter Voltage	V_{CES}	−32	V
Collector-Emitter Voltage	V_{CEO}	−32	V
Emitter-Base Voltage	V_{EBO}	−5	V
Collector Current	I_C	−200	mA
Base Current	I_B	−50	mA

CHARACTERISTICS (at 25°C ambient temperature unless otherwise stated).

Parameter		Symbol	Min.	Typ.	Max.	Unit	Test Conditions
Collector-emitter breakdown voltage		$V_{(BR)CEO}$	−32	—	—	V	I_{CEO} = −2mA
Emitter-base breakdown voltage		$V_{(BR)EBO}$	−5	—	—	V	I_{EBO} = −1 μA
Collector-emitter cut-off current		I_{CES}	— —	— —	−20 −20	nA μA	V_{CES} = −32V V_{CES} = −32V, T_{amb}=150°C
Emitter-base cut-off current		I_{EBO}	—	—	−20	nA	V_{EBO} = −4V
Collector-emitter saturation voltage		$V_{CE(sat)}$	— —	−0.12 −0.25	−0.25 −0.55	V V	I_C = −10mA, I_B = −0.25mA I_C = −50mA, I_B = −1.25mA
Base-emitter saturation voltage		$V_{BE(sat)}$	−0.60 −0.68	−0.70 −0.80	−0.85 −1.05	V V	I_C = −10mA, I_B = −0.25mA I_C = −50mA, I_B = −1.25mA
Base-emitter voltage		V_{BE}	— −0.6 —	−0.55 −0.65 −0.72	— −0.75 —	V V V	I_C = −10μA, V_{CE} = −5V I_C = −2mA, V_{CE} = −5V I_C = −50mA, V_{CE} = −1V
Static forward current transfer ratio	BCW61A	h_{FE}	— 120 60	140 170 —	— 220 —		I_C = −10μA, V_{CE} = −5V I_C = −2mA, V_{CE} = −5V I_C = −50mA, V_{CE} = −1V
	BCW61B	h_{FE}	30 180 80	200 250 —	— 310 —		I_C = −10μA, V_{CE} = −5V I_C = −2mA, V_{CE} = −5V I_C = −50mA, V_{CE} = −1V
	BCW61C	h_{FE}	40 250 100	270 350 —	— 460 —		I_C = −10μA, V_{CE} = −5V I_C = −2mA, V_{CE} = −5V I_C = −50mA, V_{CE} = −1V
	BCW61D	h_{FE}	100 380 110	340 500 —	— 630 —		I_C = −10μA, V_{CE} = −5V I_C = −2mA, V_{CE} = −5V I_C = −50mA, V_{CE} = −1V

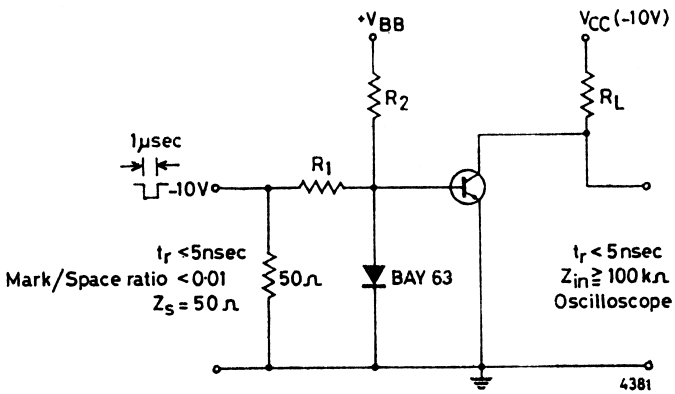
CHARACTERISTICS (continued).

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
Transition frequency	f_T	—	180	—	MHz	$I_C = -10mA$, $V_{CE} = -5V$ f=100MHz
Collector-base capacitance	C_{cbo}	—	—	6	pF	$V_{CBO} = -10V$, f=1MHz
Emitter-base capacitance	C_{ebo}	—	11	—	pF	$V_{EBO} = -0.5V$, f=1MHz
Noise figure	N	—	2	6	dB	$I_C = -0.2mA$, $V_{CE} = -5V$ $R_G = 2k\Omega$, f=1kHz $\triangle f = 200Hz$
Switching times						
Delay time	t_d	—	35	—	ns	$-I_C : -I_{B1} : I_{B2} = 10:1:1mA$ $R_1 = R_2 = 5k\Omega$ $V_{BB} = -3.6V$, $R_L = 990\Omega$
Rise time	t_r	—	50	—	ns	
Turn-on time	t_{on}	—	85	150	ns	
Storage time	t_s	—	400	—	ns	
Fall time	t_f	—	80	—	ns	
Turn-off time	t_{off}	—	480	800	ns	

FOUR TERMINAL NETWORK DATA ($I_C = 2mA$, $V_{CE} = 5V$, f = 1kHz).

	h_{FE} Group A			h_{FE} Group B			h_{FE} Group C			h_{FE} Group D			
	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
h_{11e}	1.6	2.7	4.5	2.5	3.6	6.0	3.2	4.5	8.5	4.5	7.5	12	K
h_{12e}	—	1.5	—	—	2	—	—	2	—	—	3	—	10^{-4}
h_{21e}	—	200	—	—	260	—	—	330	—	—	520	—	
h_{22e}	—	18	30	—	24	50	—	30	60	—	50	100	μs

SWITCHING CIRCUIT



Devices are identified by a code on the body of the device

BCW61A	BA
BCW61B	BB
BCW61C	BC
BCW61D	BD
BCW61AR	CA
BCW61BR	CB
BCW61CR	CC
BCW61DR	CD

NPN silicon planar medium power transistors

BCW65
BCW66

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	BCW65	BCW66	Unit
Collector-Emitter Voltage	V_{CES}	60	75	V
Collector-Emitter Voltage	V_{CEO}	32	45	V
Emitter-Base Voltage	V_{EBO}	5	5	V
Collector Current	I_C	800	800	mA
Peak Collector Current (10ms)	I_{CM}	1000	1000	mA
Base Current	I_B	100	100	mA

CHARACTERISTICS (at $T_j = 25°C$ unless otherwise stated).

Parameter		Symbol	BCW65 & BCW66			Unit	Test Conditions
			Min.	Typ.	Max.		
Collector-emitter breakdown voltage	BCW65	$V_{(BR)CEO}$	32	—	—	V	$I_{CEO} = 10mA$
	BCW66		45	—	—	V	$I_{CEO} = 10mA$
Collector-emitter breakdown voltage	BCW65	$V_{(BR)CES}$	60	—	—	V	$I_C = 10\mu A$
	BCW66		75	—	—	V	$I_C = 10\mu A$
Emitter-base breakdown voltage		$V_{(BR)EBO}$	5	—	—	V	$I_{EBO} = 10\mu A$
Collector-emitter cut-off current	BCW65	I_{CES}	—	—	20	nA	$V_{CES} = 32V$
			—	—	20	μA	$V_{CES} = 32V$, $T_{amb} = 150°C$
	BCW66	I_{CES}	—	—	20	nA	$V_{CES} = 45V$
			—	—	20	μA	$V_{CES} = 45V$, $T_{amb} = 150°C$
Emitter-base cut-off current		I_{EBO}	—	—	20	nA	$V_{EBO} = 4V$
Collector-emitter saturation voltage		$V_{CE(sat)}$	—	—	0.3	V	$I_C = 100mA$, $I_B = 10mA$
			—	—	0.7	V	$I_C = 500mA$, $I_B = 50mA$
Base-emitter saturation voltage		$V_{BE(sat)}$	—	—	2.0	V	$I_C = 500mA$, $I_B = 50mA$

CHARACTERISTICS (continued).

Parameter		Symbol	BCW65 & BCW66			Unit	Test Conditions
			Min.	Typ.	Max.		
Static forward current transfer ratio	BCW65A BCW66F	h_{FE}	35 75 100 35	— — 160 —	— — 250 —		I_C = 100 μA, V_{CE} = 10V I_C = 10 mA, V_{CE} = 1V I_C = 100 mA, V_{CE} = 1V I_C = 500 mA, V_{CE} = 2V
	BCW65B BCW66G	h_{FE}	50 110 160 60	— — 250 —	— — 400 —		I_C = 100 μA, V_{CE} = 10V I_C = 10 mA, V_{CE} = 1V I_C = 100 mA, V_{CE} = 1V I_C = 500 mA, V_{CE} = 2V
	BCW65C BCW66H	h_{FE}	80 180 250 100	— — 350 —	— — 630 —		I_C = 100 μA, V_{CE} = 10V I_C = 10 mA, V_{CE} = 1V I_C = 100 mA, V_{CE} = 1V I_C = 500 mA, V_{CE} = 2V
Transition frequency		f_T	100	—	—	MHz	I_C = 20 mA, V_{CE} = 10V f = 100 MHz
Collector-base capacitance		C_{cbo}	—	8	12	pF	V_{CBO} = 10V, f = 1 MHz
Emitter-base capacitance		C_{ebo}	—	—	80	pF	V_{EBO} = 0.5V, f = 1 MHz
Noise figure		N	—	2	10	dB	I_C = 0.2 mA, V_{CE} = 5V R_g = 1 kΩ, f = 1 kHz Δf = 200 Hz
Switching times Turn-on time Turn-off time		 t_{on} t_{off}	 — —	 — —	 100 400	 ns ns	I_C = 150 mA $I_{B1} = -I_{B2}$ = 15 mA R_L = 150Ω

Devices are identified by a code on the body of the device

BCW65A	EA
BCW65B	EB
BCW65C	EC
BCW66F	EF
BCW66G	EG
BCW66H	EH
BCW65AR	4V
BCW65BR	5V
BCW65CR	6V
BCW66FR	7P
BCW66GR	5T
BCW66HR	7M

PNP silicon planar medium power transistors

BCW67
BCW68

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	BCW67	BCW68	Unit
Collector-Emitter Voltage	V_{CES}	−45	−60	V
Collector-Emitter Voltage	V_{CEO}	−32	−45	V
Emitter-Base Voltage	V_{EBO}	−5	−5	V
Collector Current	I_C	−800	−800	mA
Peak Collector Current (10ms)	I_{CM}	−1000	−1000	mA
Base Current	I_B	−100	−100	mA

CHARACTERISTICS (at 25°C ambient temperature unless otherwise stated).

Parameter		Symbol	BCW67 & BCW68			Unit	Test Conditions
			Min.	Typ.	Max.		
Collector-emitter breakdown voltage	BCW67	$V_{(BR)CEO}$	−32	—	—	V	$I_{CEO} = -10mA$
	BCW68		−45	—	—	V	$I_{CEO} = -10mA$
Collector-emitter breakdown voltage	BCW67	$V_{(BR)CES}$	−45	—	—	V	$I_C = -10\mu A$
	BCW68		−60	—	—	V	$I_C = -10\mu A$
Emitter-base breakdown voltage		$V_{(BR)EBO}$	−5	—	—	V	$I_{EBO} = -10\mu A$
Collector-emitter cut-off current	BCW67	I_{CES}	—	—	−20	nA	$V_{CES} = -32V$
			—	—	−10	μA	$V_{CES} = -32V$, $T_{amb} = 150°C$
	BCW68	I_{CES}	—	—	−20	nA	$V_{CES} = -45V$
			—	—	−10	μA	$V_{CES} = -45V$, $T_{amb} = 150°C$
Emitter-base cut-off current		I_{EBO}	—	—	−20	nA	$V_{EBO} = -4V$
Collector-emitter saturation voltage		$V_{CE(sat)}$	—	—	−0.3	V	$I_C = -100mA$, $I_B = -10mA$
			—	−0.7	—	V	$I_C = -500mA$, $I_B = -50mA$
Base-emitter saturation voltage		$V_{BE(sat)}$	—	—	−2.0	V	$I_C = -500mA$, $I_B = -50mA$

CHARACTERISTICS (continued).

Parameter		Symbol	BCW67 & BCW68			Unit	Test Conditions
			Min.	Typ.	Max.		
Static forward current transfer ratio	BCW67A BCW68F	h_{FE}	75 100 35	— 170 —	— 250 —		$I_C = -10mA$, $V_{CE} = -1V$ $I_C = -100mA$, $V_{CE} = -1V$ $I_C = -500mA$, $V_{CE} = -2V$
	BCW67B BCW68G	h_{FE}	120 160 60	— 250 —	— 400 —		$I_C = -10mA$, $V_{CE} = -1V$ $I_C = -100mA$, $V_{CE} = -1V$ $I_C = -500mA$, $V_{CE} = -2V$
	BCW67C BCW68H	h_{FE}	180 250 100	— 350 —	— 630 —		$I_C = -10mA$, $V_{CE} = -1V$ $I_C = -100mA$, $V_{CE} = -1V$ $I_C = -500mA$, $V_{CE} = -2V$
Transition frequency		f_T	100	—	—	MHz	$I_C = -20mA$, $V_{CE} = -10V$ $f = 100MHz$
Collector-base capacitance		C_{cbo}	—	12	18	pF	$V_{CBO} = -10V$, $f = 1MHz$
Emitter-base capacitance		C_{ebo}	—	—	80	pF	$V_{EBO} = -0.5V$, $f = 1MHz$
Noise figure		N	—	2	10	dB	$I_C = -0.2mA$, $V_{CE} = -5V$ $R_g = 1k\Omega$, $f = 1kHz$ $\Delta f = 200Hz$
Switching times Turn-on time Turn-off time		t_{on} t_{off}	— —	— —	100 400	ns ns	$I_C = -150mA$ $I_{B1} = -I_{B2} = -15mA$ $R_L = 150\Omega$

Devices are identified by a code on the body of the device

BCW67A	DA
BCW67B	DB
BCW67C	DC
BCW68F	DF
BCW68G	DG
BCW68H	DH
BCW67AR	4W
BCW67BR	5W
BCW67CR	6W
BCW68FR	7T
BCW68GR	6T
BCW68HR	7N

PNP silicon planar small signal transistors

BCW69
BCW70

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	BCW69 & BCW70	Unit
Collector-Base Voltage	V_{CBO}	−50	V
Collector-Emitter Voltage	V_{CES}	−50	V
Collector-Emitter Voltage ($I_C = -2mA$)	V_{CEO}	−45	V
Emitter-Base Voltage	V_{EBO}	−5.0	V
Collector Current	I_C	−100	mA
Peak Collector Current	I_{CM}	−200	mA

CHARACTERISTICS (at $T_j = 25°C$ unless otherwise stated).

Parameter		Symbol	BCW69 & BCW70			Unit	Test Conditions
			Min.	Typ.	Max.		
Collector-base cut-off current		I_{CBO}	— —	— —	−100 −10	nA μA	$I_E = 0$, $V_{CB} = -20V$ $I_E = 0$, $V_{CB} = 20V$ $T_j = 100°C$
Base-emitter voltage		V_{BE}	−600	—	−750	mV	$I_C = -2.0mA$, $V_{CE} = -5.0V$
Collector-emitter breakdown voltage		$V_{CE(sat)}$	— —	−80 −150	−300 —	mV mV	$I_C = -10mA$, $I_B = -0.5mA$ $I_C = -50mA$, $I_B = -2.5mA$
Base-emitter saturation voltage		$V_{BE(sat)}$	— —	−720 −810	— —	mV mV	$I_C = -10mA$, $I_B = -0.5mA$ $I_C = -50mA$, $I_B = -2.5mA$
Static forward current transfer ratio	BCW69	h_{FE}	— 120	90 —	— 260		$I_C = -10\mu A$, $V_{CE} = -5.0V$ $I_C = -2.0mA$, $V_{CE} = -5.0V$
	BCW70	h_{FE}	— 215	150 —	— 500		$I_C = -10\mu A$, $V_{CE} = -5.0V$ $I_C = -2.0mA$, $V_{CE} = -5.0V$
Transition frequency		f_T	—	150	—	MHz	$I_C = -10mA$, $V_{CE} = -5.0V$ $f = 35MHz$
Collector capacitance		C_{Tc}	—	—	7	pF	$I_E = I_e = 0$, $V_{CB} = -10V$ $f = 1MHz$
Noise figure		N	—	—	10	dB	$I_C = -200\mu A$, $V_{CE} = -5.0V$ $R_S = 2.0k\Omega$, $f = 1kHz$ $B = 200Hz$

Devices are identified by a code on the body of the device

BCW69	H1
BCW70	H2
BCW69R	H4
BCW70R	H5

NPN silicon planar small signal transistors

BCW71
BCW72

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	BCW71 & BCW72	Unit
Collector-Base Voltage	V_{CBO}	50	V
Collector-Emitter Voltage (I_C = 2.0mA)	V_{CEO}	45	V
Emitter-Base Voltage	V_{EBO}	5.0	V
Collector Current	I_C	100	mA
Peak Collector Current	I_{CM}	200	mA

CHARACTERISTICS (at T_j = 25°C unless otherwise stated).

Parameter		Symbol	BCW71 & BCW72			Unit	Test Conditions
			Min.	Typ.	Max.		
Collector-base cut-off current		I_{CBO}	— —	— —	100 10	nA μA	I_E = 0, V_{CB} = 20V I_E = 0, V_{CB} = 20V T_j = 100°C
Base-emitter voltage		V_{BE}	550	—	700	mV	I_C = 2.0mA, V_{CE} = 5V
Collector-emitter saturation voltage		$V_{CE(sat)}$	— —	120 210	250 —	mV mV	I_C = 10mA, I_B = 0.5mA I_C = 50mA, I_B = 2.5mA
Base-emitter saturation voltage		$V_{BE(sat)}$	— —	750 850	— —	mV mV	I_C = 10mA, I_B = 0.5mA I_C = 50mA, I_B = 2.5mA
Static forward current transfer ratio	BCW71	h_{FE}	— 110	90 —	— 220		I_C = 10μA, V_{CE} = 5V I_C = 2mA, V_{CE} = 5V
	BCW72	h_{FE}	— 200	150 —	— 450		I_C = 10μA, V_{CE} = 5V I_C = 2mA, V_{CE} = 5V
Transition frequency		f_T	—	300	—	MHz	I_C = 10mA, V_{CE} = 5V f = 35MHz
Collector capacitance		C_{Tc}	—	—	4	pF	I_E = I_e = 0, V_{CB} = 10V f = 1MHz
Noise figure		N	—	—	10	dB	I_C = 200μA, V_{CE} = 5V R_s = 2kΩ, f = 1kHz B = 200Hz

Devices are identified by a code on the body of the device

BCW71	K1
BCW72	K2
BCW71R	K4
BCW72R	K5

PNP Silicon planar small signal transistor

BCW89

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Collector-Base Voltage	V_{CBO}	−80	V
Collector-Emitter Voltage	V_{CES}	−60	V
Collector-Emitter Voltage ($I_C = -2mA$)	V_{CEO}	−60	V
Emitter-Base Voltage	V_{EBO}	−5.0	V
Collector Current	I_C	−100	mA
Peak Collector Current	I_{CM}	−200	mA

CHARACTERISTICS (at $T_j = 25°C$ unless otherwise stated).

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Collector-base cut-off current	I_{CBO}	— —	— —	−100 −10	nA μA	$I_E = 0$, $V_{CB} = -20V$ $I_E = 0$, $V_{CB} = -20V$ $T_j = 100°C$
Base-emitter voltage	V_{BE}	−600	—	−750	mV	$I_C = -2.0mA$, $V_{CE} = -5.0V$
Collector-emitter saturation voltage	$V_{CE(sat)}$	— —	−80 −150	−300 —	mV mV	$I_C = -10mA$, $I_B = -0.5mA$ $I_C = -50mA$, $I_B = -2.5mA$
Base-emitter saturation voltage	$V_{BE(sat)}$	— —	−720 −810	— —	mV mV	$I_C = -10mA$, $I_B = -0.5mA$ $I_C = -50mA$, $I_B = -2.5mA$
Static forward current transfer ratio	h_{FE}	— 120	90 —	— 260		$I_C = -10\mu A$, $V_{CE} = -5.0V$ $I_C = -2.0mA$, $V_{CE} = -5.0V$
Transition frequency	f_T	—	150	—	MHz	$I_C = -10mA$, $V_{CE} = -5.0V$ $f = 35MHz$
Collector capacitance	C_{Tc}	—	—	7	pF	$I_E = I_e = 0$, $V_{CB} = -10V$ $f = 1MHz$
Noise figure	N	—	—	10	dB	$I_C = -200\mu A$, $V_{CE} = -5.0V$ $R_s = 2.0k\Omega$, $f = 1kHz$ $B = 200Hz$

Devices are identified by a code on the body of the device

BCW89 . . . . . H3
BCW89R H6

PNP silicon planar medium power transistors

BCX17
BCX18

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	BCX17	BCX18	Unit
Collector-Emitter Voltage	V_{CES}	−50	−30	V
Collector-Emitter Voltage (I_C = −10mA)	V_{CEO}	−45	−25	V
Emitter-Base Voltage	V_{EBO}	−5.0	−5.0	V
Collector Current	I_C	−500	−500	mA
Peak Collector Current	I_{CM}	−1000	−1000	mA
Peak Emitter Current	I_{EM}	−1000	−1000	mA
Base Current	I_B	−100	−100	mA
Peak Base Current	I_{BM}	−200	−200	mA

CHARACTERISTICS (at T_j = 25°C unless otherwise stated).

Parameter	Symbol	BCX17 & BCX18			Unit	Test Conditions
		Min.	Typ.	Max.		
Collector-base cut-off current	I_{CBO}	—	—	−100	nA	I_E = 0, V_{CB} = −20V
		—	—	−200	μA	I_E = 0, V_{CB} = −20V T_j = 150°C
Emitter-base cut-off current	I_{EBO}	—	—	−10	μA	I_C = 0, V_{EB} = −5V
Base-emitter voltage	V_{BE}	—	—	−1.2	V	I_C = −500mA V_{CE} = −50mA
Collector-emitter saturation voltage	$V_{CE(sat)}$	—	—	−620	mV	I_C = −500mA, I_B = −50mA
Static forward current transfer ratio	h_{FE}	100	—	600		I_C = −100mA V_{CE} = −1V
		70	—	—		I_C = −300mA V_{CE} = −1V
		40	—	—		I_C = −500mA V_{CE} = −1V
Transition frequency	f_T	—	100	—	MHz	I_C = −10mA V_{CE} = −5V f = 35MHz
Collector capacitance	C_{Tc}	—	8.0	—	pF	I_E = I_e = 0 V_{CB} = −10V f = 1MHz

Devices are identified by a code on the body of the device

BCX17	T1
BCX18	T2
BCX17R	T4
BCX18R	T5

NPN silicon planar medium power transistors

BCX19
BCX20

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	BCX19	BCX20	Unit
Collector-Emitter Voltage	V_{CES}	50	30	V
Collector-Emitter Voltage (I_C=10mA)	V_{CEO}	45	25	V
Emitter-Base Voltage	V_{EBO}	5.0	5.0	V
Collector Current	I_C	500	500	mA
Peak Collector Current	I_{CM}	1000	1000	mA
Peak Emitter Current	I_{EM}	1000	1000	mA
Base Current	I_B	100	100	mA
Peak Base Current	I_{BM}	200	200	mA

CHARACTERISTICS (at T_j=25°C unless otherwise stated).

Parameter	Symbol	BCX19 & BCX20			Unit	Test Conditions
		Min.	Typ.	Max.		
Collector-base cut-off current	I_{CBO}	—	—	100	nA	I_E=0, V_{CB}=20V
		—	—	200	μA	I_E=0, V_{CB}=20V T_j=150°C
Emitter-base cut-off current	I_{EBO}	—	—	10	μA	I_C=0, V_{EB}=5V
Base-emitter voltage	V_{BE}	—	—	1.2	V	I_C=500mA V_{CE}=1V
Collector-emitter saturation voltage	$V_{CE(sat)}$	—	—	620	mV	I_C=500mA, I_B=50mA
Static forward current transfer ratio	h_{FE}	100	—	600		I_C=100mA V_{CE}=1V
		70	—	—		I_C=300mA V_{CE}=1V
		40	—	—		I_C=500mA V_{CE}=1V
Transition frequency	f_T	—	200	—	MHz	I_C=10mA V_{CE}=5V f=35MHz
Collector capacitance	C_{Tc}	—	5.0	—	pF	I_E=I_e=0 V_{CB}=10V f=1MHz

Devices are identified by a code on the body of the device

BCX19	U1
BCX20	U2
BCX19R	U4
BCX20R	U5

NPN silicon planar medium power transistor

BCX41

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	BCX41	Unit
Collector-Emitter Voltage (I_C = 100μA)	V_{CES}	125	V
Collector-Emitter Voltage (I_C = 10mA)	V_{CEO}	125	V
Collector Current	I_C	800	mA
Peak Collector Current	I_{CM}	1000	mA
Base Current	I_B	100	mA

CHARACTERISTICS (at T_{amb} = 25°C unless otherwise specified).

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
Collector-base cut-off current	I_{CES}	–	–	100	nA	V_{CE} = 100V
		–	–	10	μA	V_{CE} = 100V, T_{amb} = 150°C
	I_{CEX}	–	–	10	μA	V_{CE} = 100V, T_{amb} = 85°C, V_{BE} = 0.2V
		–	–	75	μA	V_{CE} = 100V, T_{amb} = 125°C V_{BE} = 0.2V
Emitter-base cut-off current	I_{EBO}	–	–	100	nA	V_{EB} = 4V
Base-emitter saturation voltage	$V_{BE(sat)}$	–	–	1.4	V	I_C = 300mA, I_B = 30mA
Collector-emitter saturation voltage	$V_{CE(sat)}$	–	–	0.9	V	I_C = 300mA, I_B = 30mA
Static forward current transfer ratio	h_{FE}	25	–	–		I_C = 100μA, V_{CE} = 1V
		63	–	–		I_C = 100mA, V_{CE} = 1V
		40	–	–		I_C = 200mA, V_{CE} = 1V
Transition frequency	f_T	–	100	–	MHz	I_C = 10mA, V_{CE} = 5V, f = 20MHz
Collector-base capacitance	C_{obo}	–	12	–	pF	V_{CB} = 10V, I_E = 0V, f = 1MHz

Devices are identified by a code on the body of the device

BCX41 . . . . . EK

NPN silicon planar small signal transistor

BCX70

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	BCX70	Unit
Collector-Emitter Voltage	V_{CES}	45	V
Collector-Emitter Voltage	V_{CEO}	45	V
Emitter-Base Voltage	V_{EBO}	5	V
Collector Current	I_C	200	mA
Base Current	I_B	50	mA

CHARACTERISTICS (at 25°C ambient temperature unless otherwise stated).

Parameter		Symbol	Min.	Typ.	Max.	Unit	Test Conditions
Collector-emitter breakdown voltage		$V_{(BR)CEO}$	45	—	—	V	$I_{CEO}=2mA$
Emitter-base breakdown voltage		$V_{(BR)EBO}$	5	—	—	V	$I_{EBO}=1\mu A$
Collector-emitter cut-off current		I_{CES}	— —	— —	20 20	nA μA	$V_{CES}=45V$ $V_{CES}=45V$, $T_{amb}=150°C$
Emitter-base cut-off current		I_{EBO}	—	—	20	nA	$V_{EBO}=4V$
Collector-emitter saturation voltage		$V_{CE(sat)}$	— —	0.12 0.20	0.35 0.55	V V	$I_C=10mA$, $I_B=0.25mA$ $I_C=50mA$, $I_B=1.25mA$
Base-emitter saturation voltage		$V_{BE(sat)}$	0.60 0.70	0.70 0.83	0.85 1.05	V V	$I_C=10mA$, $I_B=0.25mA$ $I_C=50mA$, $I_B=1.25mA$
Base-emitter voltage		V_{BE}	— 0.55 —	0.52 0.65 0.78	— 0.75 —	V V V	$I_C=10\mu A$, $V_{CE}=5V$ $I_C=2mA$, $V_{CE}=5V$ $I_C=50mA$, $V_{CE}=1V$
Static forward current transfer ratio	BCX70G	h_{FE}	— 120 50	78 170 —	— 220 —		$I_C=10\mu A$, $V_{CE}=5V$ $I_C=2mA$, $V_{CE}=5V$ $I_C=50mA$, $V_{CE}=1V$
	BCX70H	h_{FE}	20 180 70	145 250 —	— 310 —		$I_C=10\mu A$, $V_{CE}=5V$ $I_C=2mA$, $V_{CE}=5V$ $I_C=50mA$, $V_{CE}=1V$
	BCX70J	h_{FE}	40 250 90	220 350 —	— 460 —		$I_C=10\mu A$, $V_{CE}=5V$ $I_C=2mA$, $V_{CE}=5V$ $I_C=50mA$, $V_{CE}=1V$
	BCX70K	h_{FE}	100 380 100	300 500 —	— 630 —		$I_C=10\mu A$, $V_{CE}=5V$ $I_C=2mA$, $V_{CE}=5V$ $I_C=50mA$, $V_{CE}=1V$

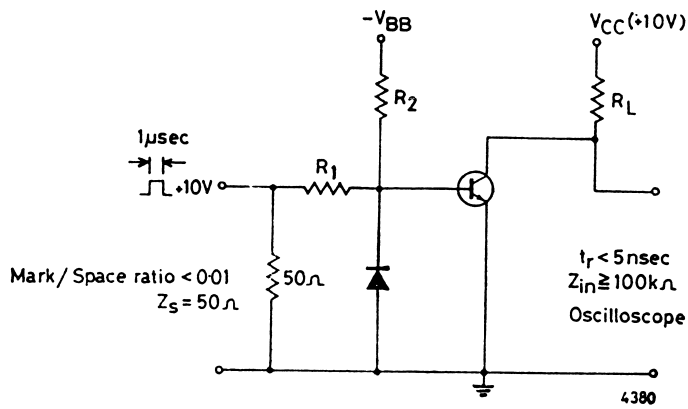
CHARACTERISTICS (continued).

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
Transition frequency	f_T	125	250	—	MHz	I_C=10mA, V_{CE}=5V f=100MHz
Collector-base capacitance	C_{cbo}	—	—	4.5	pF	V_{CBO}=10V, f=1MHz
Emitter-base capacitance	C_{ebo}	—	8	—	pF	V_{EBO}=0.5V, f=1MHz
Noise figure	N	—	2	6	dB	I_C=0.2mA, V_{CE}=5V R_G=2kΩ, f=1kHz Δf=200Hz
Switching times						
Delay time	t_d	—	35	—	ns	I_C:I_{B1}:−I_{B2}=10:1:1mA R_1=5kΩ, R_2=5kΩ V_{BB}=3.6V, R_L=990Ω
Rise time	t_r	—	50	—	ns	
Turn-on time	t_{on}	—	85	150	ns	
Storage time	t_s	—	400	—	ns	
Fall time	t_f	—	80	—	ns	
Turn-off time	t_{off}	—	480	800	ns	

FOUR TERMINAL NETWORK DATA (I_C=2mA, V_{CE}=5V, f=1kHz).

	h_{FE} Group G			h_{FE} Group H			h_{FE} Group J			h_{FE} Group K			Units
	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
h_{11e}	1.6	2.7	4.5	2.5	3.6	6.0	3.2	4.5	8.5	4.5	7.5	12	K
h_{12e}	—	1.5	—	—	2	—	—	2	—	—	3	—	10^{-4}
h_{21e}	—	200	—	—	260	—	—	330	—	—	520	—	
h_{22e}	—	18	30	—	24	50	—	30	60	—	50	100	μs

SWITCHING CIRCUIT



Devices are identified by a code on the body of the device

BCX70G	AG
BCX70H	AH
BCX70J	AJ
BCX70K	AK
BCX70GR	AW
BCX70HR	9P
BCX70JR	AX
BCX70KR	P9

PNP silicon planar small signal transistor

BCX71

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	BCX71	Unit
Collector-Emitter Voltage	V_{CES}	−45	V
Collector-Emitter Voltage	V_{CEO}	−45	V
Emitter-Base Voltage	V_{EBO}	−5	V
Collector Current	I_C	−200	mA
Base Current	I_B	−50	mA

CHARACTERISTICS (at 25°C ambient temperature unless otherwise stated).

Parameter		Symbol	Min.	Typ.	Max.	Unit	Test Conditions
Collector-emitter breakdown voltage		$V_{(BR)CEO}$	−45	—	—	V	$I_{CEO} = -2mA$
Emitter-base breakdown voltage		$V_{(BR)EBO}$	−5	—	—	V	$I_{EBO} = -1\mu A$
Collector-emitter cut-off current		I_{CES}	— —	— —	−20 −60	nA μA	$V_{CES} = -45V$ $V_{CES} = -45V$, $T_{amb} = 150°C$
Emitter-base cut-off current		I_{EBO}	—	—	−20	nA	$V_{EBO} = -4V$
Collector-emitter saturation voltage		$V_{CE(sat)}$	— —	−0.12 −0.25	−0.25 −0.55	V V	$I_C = -10mA$, $I_B = -0.25mA$ $I_C = -50mA$, $I_B = -1.25mA$
Base-emitter saturation voltage		$V_{BE(sat)}$	−0.60 −0.68	−0.70 −0.80	−0.85 −1.05	V V	$I_C = -10mA$, $I_B = -0.25mA$ $I_C = -50mA$, $I_B = -1.25mA$
Base-emitter voltage		V_{BE}	— −0.6 —	−0.55 −0.65 −0.72	— −0.75 —	V V V	$I_C = -10\mu A$, $V_{CE} = -5V$ $I_C = -2mA$, $V_{CE} = -5V$ $I_C = -50mA$, $V_{CE} = -1V$
Static forward current transfer ratio	BCX71G	h_{FE}	— 120 60	140 170 —	— 220 —		$I_C = -10\mu A$, $V_{CE} = -5V$ $I_C = -2mA$, $V_{CE} = -5V$ $I_C = -50mA$, $V_{CE} = -1V$
	BCX71H	h_{FE}	30 180 80	200 250 —	— 310 —		$I_C = -10\mu A$, $V_{CE} = -5V$ $I_C = -2mA$, $V_{CE} = -5V$ $I_C = -50mA$, $V_{CE} = -1V$
	BCX71J	h_{FE}	40 250 100	270 350 —	— 460 —		$I_C = -10\mu A$, $V_{CE} = -5V$ $I_C = -2mA$, $V_{CE} = -5V$ $I_C = -50mA$, $V_{CE} = -1V$
	BCX71K	h_{FE}	100 380 110	340 500 —	— 630 —		$I_C = -10\mu A$, $V_{CE} = -5V$ $I_C = -2mA$, $V_{CE} = -5V$ $I_C = -50mA$, $V_{CE} = -1V$

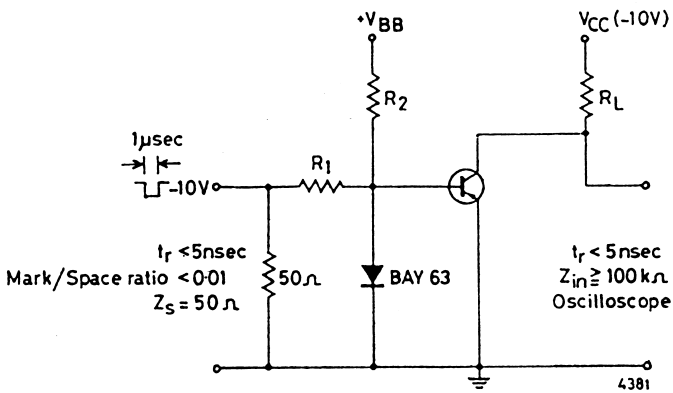
CHARACTERISTICS (continued).

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
Transition frequency	f_T	—	180	—	MHz	$I_C = -10mA$, $V_{CE} = -5V$ f = 100MHz
Collector-base capacitance	C_{cbo}	—	—	6	pF	$V_{CBO} = -10V$, f = 1 MHz
Emitter-base capacitance	C_{ebo}	—	11	—	pF	$V_{EBO} = -0.5V$, f = 1 MHz
Noise figure	N	—	2	6	dB	$I_C = -0.2mA$, $V_{CE} = -5V$ $R_G = 2k\Omega$, f = 1 kHz $\Delta f = 200Hz$
Switching times						
Delay time	t_d	—	35	—	ns	$-I_C : -I_{B1} : I_{B2} = 10:1:1mA$ $R_1 = 5k\Omega$, $R_2 = 5k\Omega$ $V_{BB} = -3.6V$, $R_L = 990\Omega$
Rise time	t_r	—	50	—	ns	
Turn-on time	t_{on}	—	85	150	ns	
Storage time	t_s	—	400	—	ns	
Fall time	t_f	—	80	—	ns	
Turn-off time	t_{off}	—	480	800	ns	

FOUR TERMINAL NETWORK DATA ($I_C = 2mA$, $V_{CE} = 5V$, f = 1 kHz).

	h_{FE} Group G			h_{FE} Group H			h_{FE} Group J			h_{FE} Group K			Units
	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
h_{11e}	1.6	2.7	4.5	2.5	3.6	6.0	3.2	4.5	8.5	4.5	7.5	12	K
h_{12e}	—	1.5	—	—	2	—	—	2	—	—	3	—	10^{-4}
h_{21e}	—	200	—	—	260	—	—	330	—	—	520	—	
h_{22e}	—	18	30	—	24	50	—	30	60	—	50	100	μs

SWITCHING CIRCUIT



Devices are identified by a code on the body of the device

BCX71G	BG
BCX71H	BH
BCX71J	BJ
BCX71K	BK
BCX71GR	CG
BCX71HR	6P
BCX71JR	J8
BCX71KR	CK

NPN silicon planar VHF/UHF transistors

BFQ31
BFQ31A

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	BFQ31/BFQ31A	Unit
Collector-Base Voltage	V_{CBO}	30	V
Collector-Emitter Voltage	V_{CEO}	15	V
Emitter-Base Voltage	V_{EBO}	3	V
Collector Current	I_C	100	mA
Base Current	I_B	50	mA

CHARACTERISTICS (at 25°C ambient temperature unless otherwise stated).

Parameter	Symbol	BFQ31		BFQ31A		Unit	Test Conditions
		Min.	Max.	Min.	Max.		
Collector-base breakdown voltage	$V_{(BR)CBO}$	30	—	30	—	V	$I_C = 1.0\mu A$, $I_F = 0$
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	15	—	15	—	V	$I_C = 3mA$, $I_B = 0$
Emitter-base breakdown voltage	$V_{(BR)EBO}$	3	—	3	—	V	$I_E = 10\mu A$, $I_C = 0$
Collector-base cut-off current	I_{CBO}	—	0.01	—	0.01	μA	$V_{CB} = 15V$, $I_E = 0$
Collector-emitter saturation voltage	$V_{CE(sat)}$	—	0.4	—	0.4	V	$I_C = 10mA$, $I_B = 1mA$
Base-emitter saturation voltage	$V_{BE(sat)}$	—	1.0	—	1.0	V	$I_C = 10mA$, $I_B = 1mA$
Static forward current transfer ratio	h_{FE}	20	—	100	—		$I_C = 3mA$, $V_{CE} = 1V$
Transition frequency	f_T	600	—	600	—	MHz	$V_{CE} = 10V$, $I_C = 4mA$ $f = 100MHz$
Output capacitance	C_{obo}	—	1.7	—	1.7	pF	$V_{CB} = 10V$, $f = 1MHz$
Input capacitance	C_{ibo}	—	2.0	—	2.0	pF	$V_{CB} = 0.5V$, $f = 1MHz$
Noise figure	N	—	6.0	—	6.0	dB	$I_C = 1mA$, $V_{CE} = 6V$ $R_S = 400\Omega$, $f = 60MHz$

Devices are identified by a code on the body of the device

BFQ31	S2
BFQ31A	S4
BFQ31R	S3
BFQ31AR	S5

NPN silicon planar RF transistor

BFS17

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Collector-Base Voltage	V_{CBO}	25	V
Collector-Emitter Voltage	V_{CEO}	15	V
Emitter-Base Voltage	V_{EBO}	2.5	V
Collector Current	I_C	25	mA
Peak Collector Current	I_{CM}	50	mA

CHARACTERISTICS (at $T_j = 25°C$ unless otherwise stated).

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
Collector cut-off current	I_{CBO}	— —	— —	10 10	nA μA	$I_E = 0$, $V_{CB} = 10V$ $I_E = 0$, $V_{CB} = 10V$, $T_j = 100°C$
Static forward-current transfer ratio	h_{FE}	25 20	— —	150 125		$I_C = 2.0mA$, $V_{CE} = 1.0V$ $I_C = 25mA$, $V_{CE} = 1.0V$
Transition frequency	f_T	—	1.0	—	GHz	$I_C = 2.0mA$, $V_{CE} = 5.0V$ $f = 500MHz$
		—	1.3	—	GHz	$I_C = 25mA$, $V_{CE} = 5.0V$ $f = 500MHz$
Feedback capacitance	$-C_{re}$	—	0.85	—	pF	$I_C = 2.0mA$, $V_{CE} = 5.0V$ $f = 1.0MHz$
Collector capacitance	C_{Tc}	—	—	1.5	pF	$I_E = I_e = 0$, $V_{CB} = 10V$ $f = 1.0MHz$
Emitter capacitance	C_{Te}	—	—	2.0	pF	$I_C = I_c = 0$, $V_{EB} = 0.5V$ $f = 1.0MHz$
Noise figure*	N	—	4.5	—	dB	$I_C = 2.0mA$, $V_{CE} = 5.0V$ $R_S = 50Ω$, $f = 500MHz$
Intermodulation distortion	d_{im}	—	−45	—	dB	$I_C = 10mA$, $V_{CE} = 6.0V$ $R_L = 37.5Ω$, $T_{amb} = 25°C$ $V_o = 100mV$ at $f_p = 183MHz$ $V_o = 100mV$ at $f_p = 200MHz$ measured at $f_{(2q-p)} = 217MHz$

*Chip mounted in a TO-18 envelope.

Devices are identified by a code on the body of the device:

BFS17 . . . . . E1

N-channel enhancement mode vertical DMOS FET

BS170F

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	SOT-23	Unit
Drain-source voltage	V_{DS}	60	V
Continuous drain current (at $T_A = 25°C$)	I_D	0.15	A
Pulse drain current	I_{DM}	3	A
Gate-source voltage	V_{GS}	±20	V

CHARACTERISTICS (at T=25°C unless otherwise stated).

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Drain-source breakdown voltage	BV_{DSS}	60	90	—	V	$I_D = 100\mu A$, $V_{GS} = 0V$
Gate-source threshold voltage	$V_{GS(th)}$	0.8	—	3	V	$I_D = 1mA$, $V_{DS} = V_{GS}$
Gate body leakage	I_{GSS}	—	—	10	nA	$V_{GS} = 15V$, $V_{DS} = 0V$
Zero gate voltage drain current	I_{DSS}	—	—	0.5	μA	$V_{DS} = 25V$, $V_{GS} = 0V$
Static drain-source on-state resistance (1)	$R_{DS(on)}$	—	—	5	Ω	$I_D = 200mA$, $V_{GS} = 10V$
Forward transconductance (1) (2)	g_{fs}	—	200	—	mS	$V_{DS} = 10V$, $I_D = 200mA$
Input capacitance (2)	C_{iss}	—	60	—	pF	$V_{DS} = 10V$, $V_{GS} = 0V$ f=1 MHz
Turn-on time (2) (3)	$t_{(on)}$	—	—	10	ns	$V_{DD} \approx 15V$, $I_D = 600mA$
Turn-off time (2) (3)	t_{off}	—	—	10	ns	

(1) Measured under pulsed conditions. Width=300μs, Duty cycle ⩽ 2%.
(2) Sample test.
(3) Switching times measured with 50Ω source impedance and < 5ns rise time on a pulse generator.

Devices are identified by a code on the body of the device

BS170F . . . . . MV

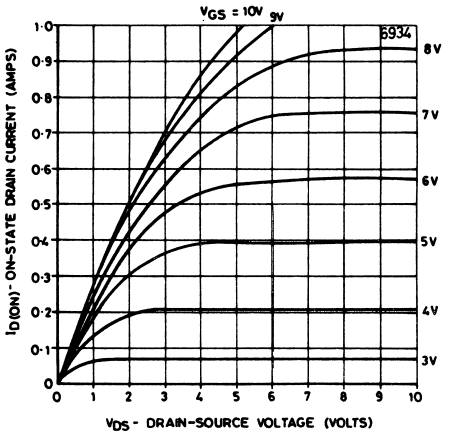


Fig 1. Typical saturation characteristics

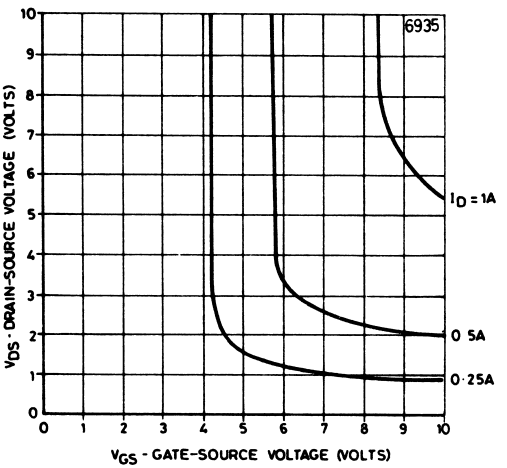


Fig 2. Typical voltage saturation characteristics

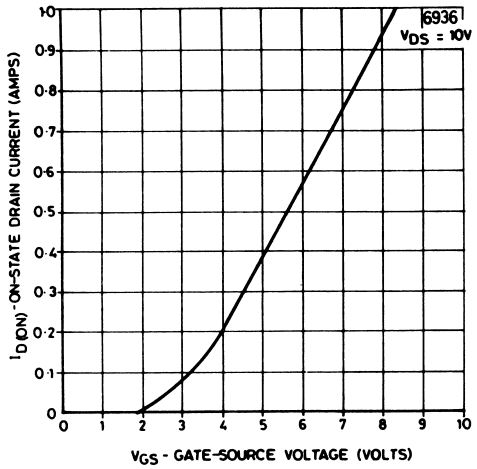


Fig 3. Typical transfer characteristics

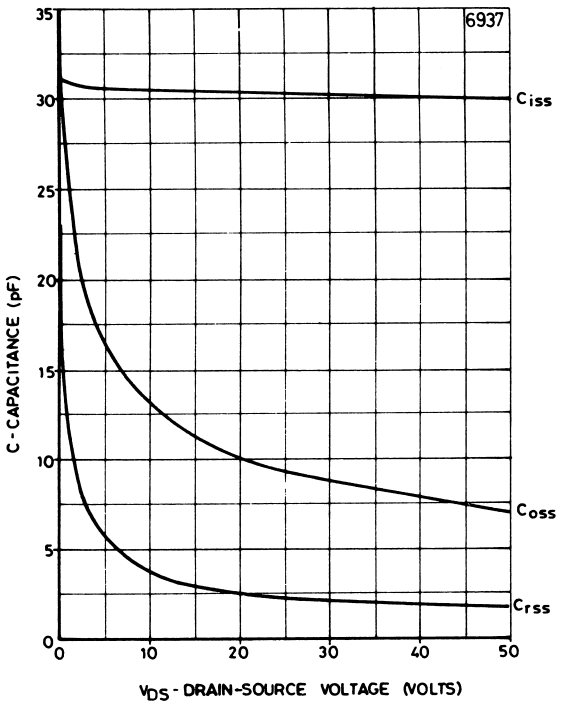


Fig 4. Typical capacitance v drain-source voltage

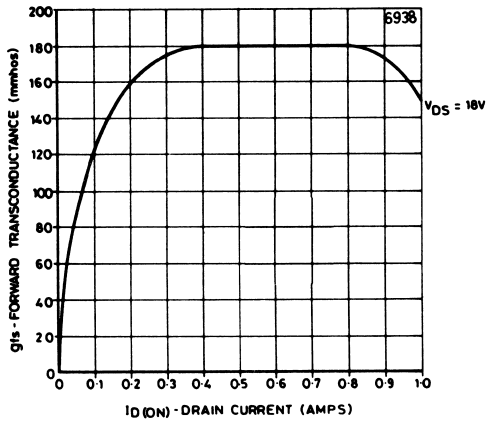


Fig 5. Typical transconductance v drain current

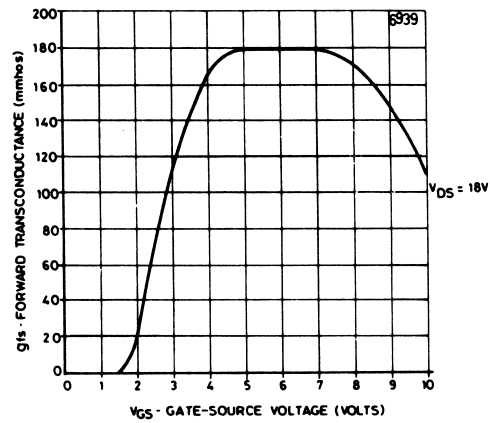


Fig 6. Typical transconductance v gate-source voltage

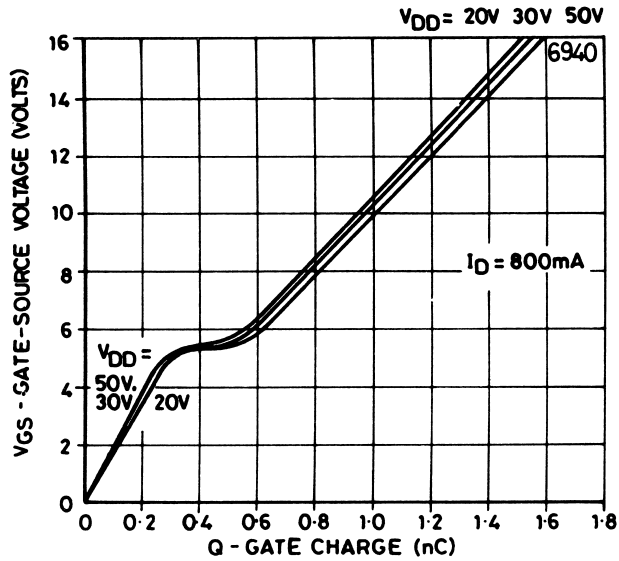


Fig 7. Typical gate charge v gate-source voltage

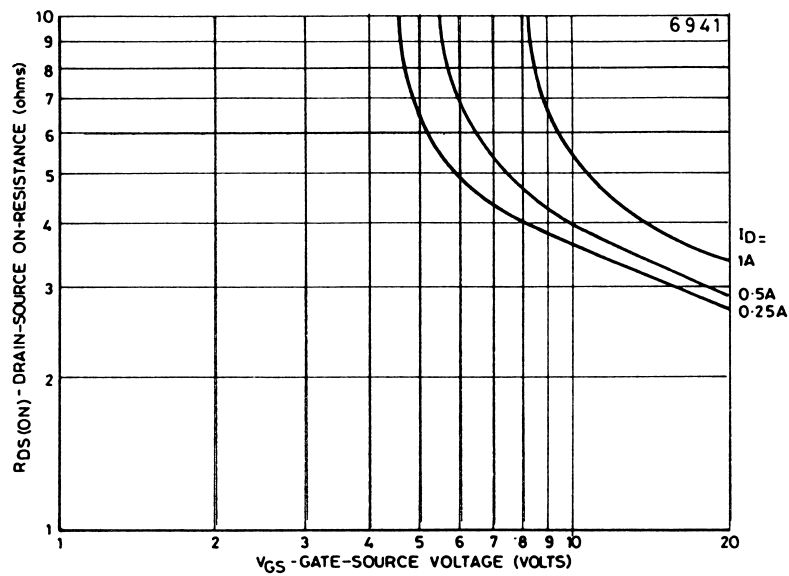


Fig 8. Typical on-resistance v gate-source voltage

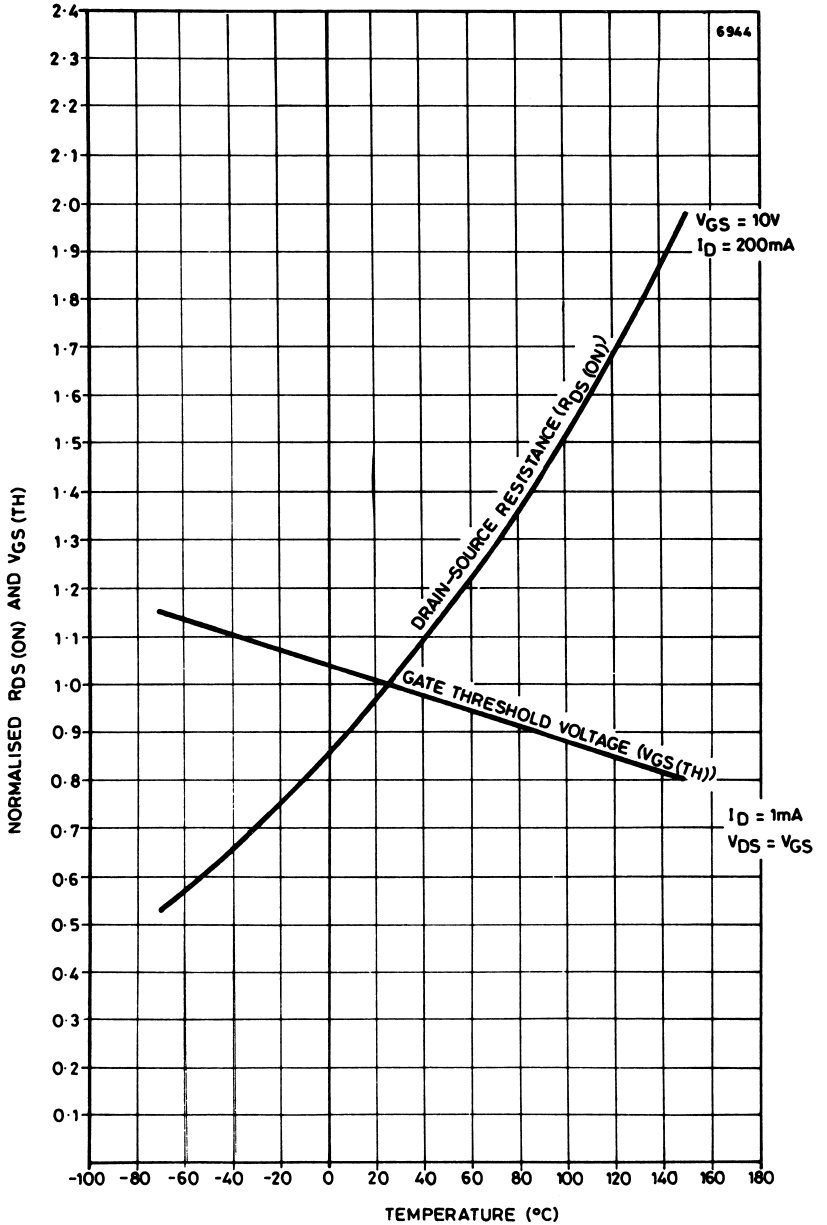


Fig 9. Normalised $R_{DS(on)}$ and $V_{GS(th)}$ v temperature

P-channel enhancement mode vertical DMOS FET

BS250F

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	SOT-23	Unit
Drain-source voltage	V_{DS}	−45	V
Continuous drain current (at T_A=25°C)	I_D	−0.09	A
Pulse drain current	I_{DM}	−1.6	A
Gate-source voltage	V_{GS}	±20	V

ELECTRICAL CHARACTERISTICS (at T=25°C unless otherwise stated).

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Drain-source breakdown voltage	BV_{DSS}	−45	−70	—	V	I_D=−100μA, V_{GS}=0V
Gate-source threshold voltage	$V_{GS(th)}$	−1	—	−3.5	V	I_D=−1mA, V_{DS}=V_{GS}
Gate body leakage	I_{GSS}	—	—	−20	nA	V_{GS}=−15V, V_{DS}=0V
Zero gate voltage drain current	I_{DSS}	—	—	−0.5	μA	V_{DS}=−25V, V_{GS}=0V
Static drain-source on-state resistance (1)	$R_{DS(on)}$	—	9	14	Ω	I_D=−200mA, V_{GS}=−10V
Forward transconductance (1) (2)	g_{fs}	—	90	—	mS	V_{DS}=−10V, I_D=−200mA
Input capacitance (2)	C_{iss}	—	25	—	pF	V_{DS}=−10V, V_{GS}=0V f=1MHz
Turn-on delay time (2) (3)	$t_{d(on)}$	—	—	10	ns	V_{DD}≈−25V, I_D=−200mA
Rise time (2) (3)	t_r	—	—	10	ns	
Turn-off delay time (2) (3)	$t_{d(off)}$	—	—	10	ns	
Fall time (2) (3)	t_f	—		10	ns	

(1) Measured under pulsed conditions. Width=300μs, Duty cycle≤2%.
(2) Sample test.
(3) Switching times measured with 50Ω source impedance and <5ns rise time on a pulse generator.

Devices are identified by a code on the body of the device

BS250F . . . . . MX

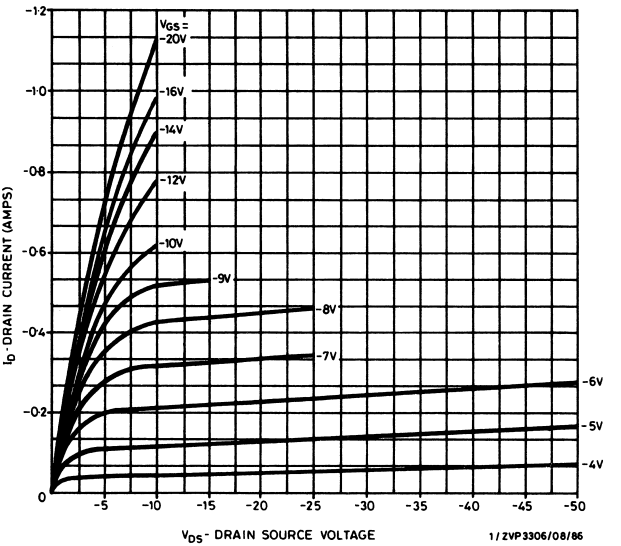


Fig 1. Typical output characteristics

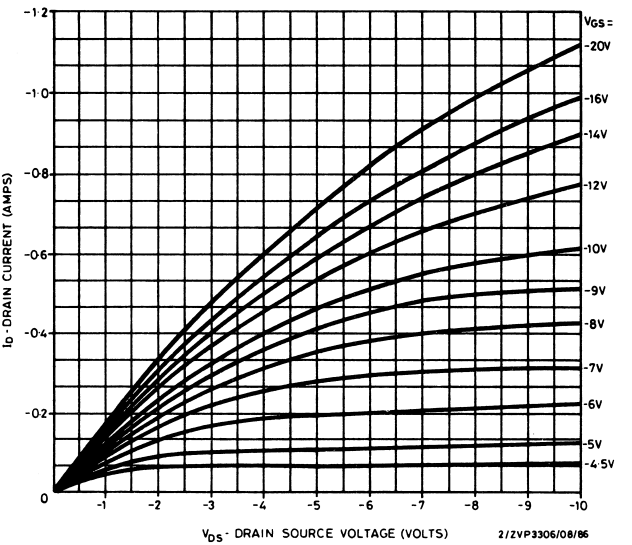


Fig 2. Typical saturation characteristics

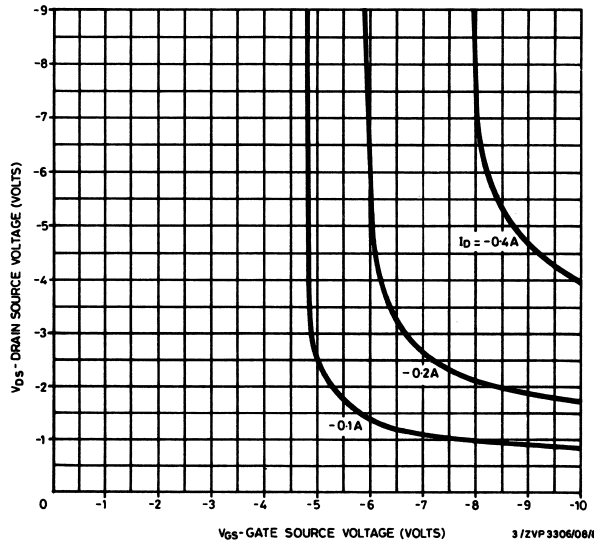


Fig 3. Typical voltage saturation characteristics

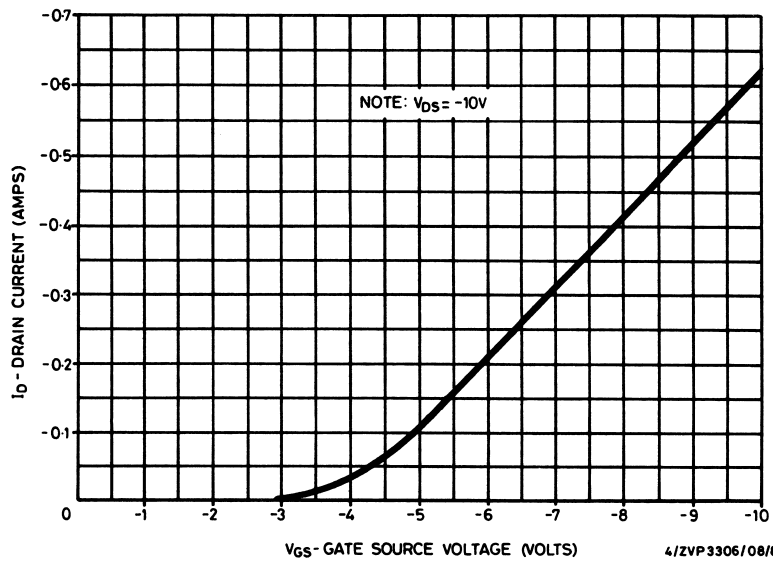


Fig 4. Typical transfer characteristics

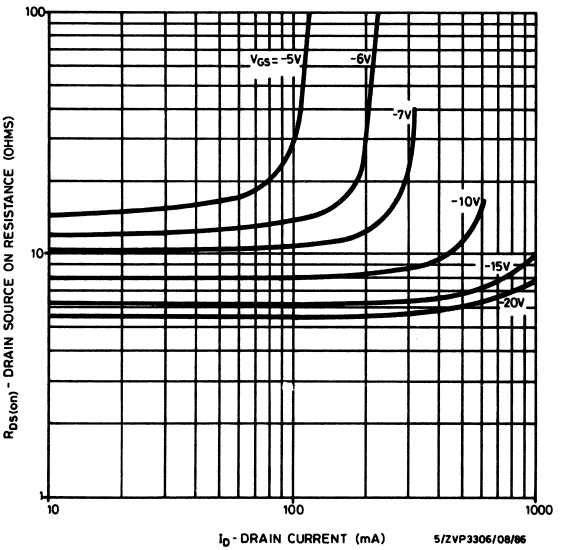


Fig 5. Typical on-resistance v drain current

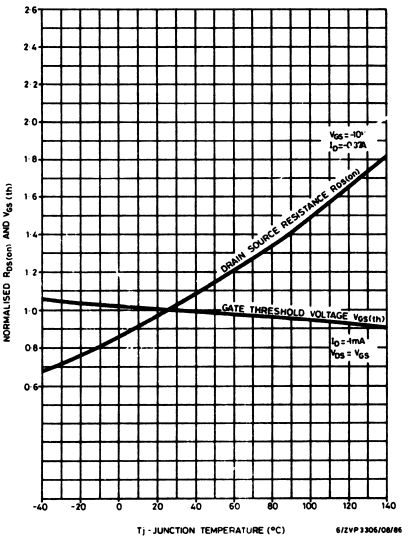


Fig 6. Normalised $R_{DS(on)}$ and $V_{GS(th)}$ v temperature

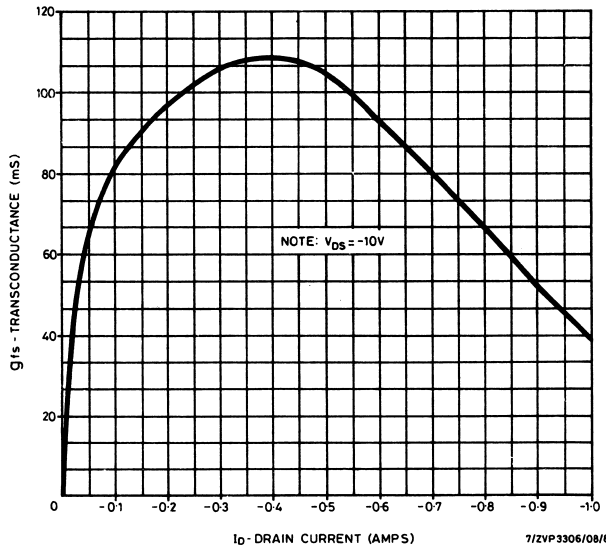


Fig 7. Typical transconductance v drain current

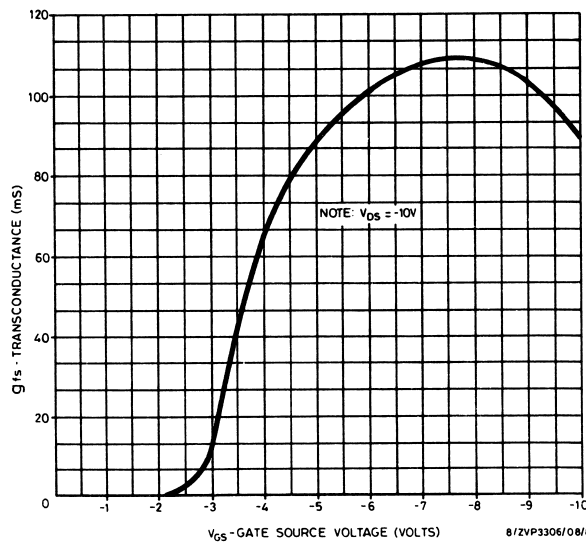


Fig 8. Typical transconductance v gate-source voltage

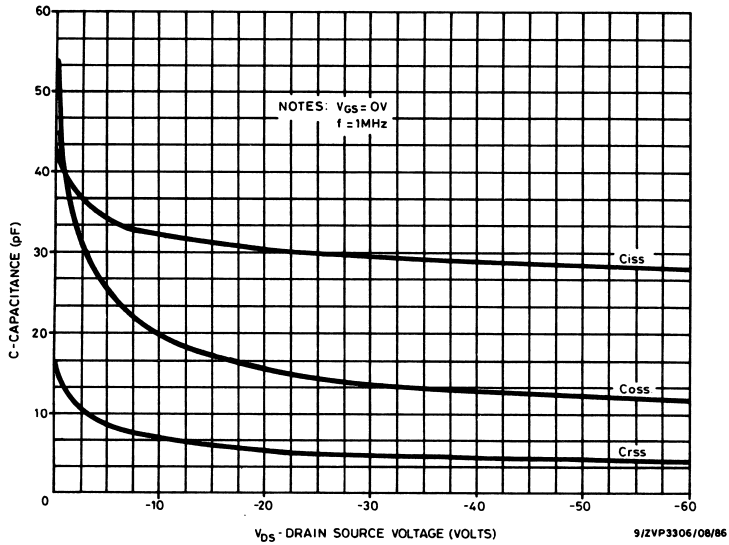


Fig 9. Typical capacitance v drain-source voltage

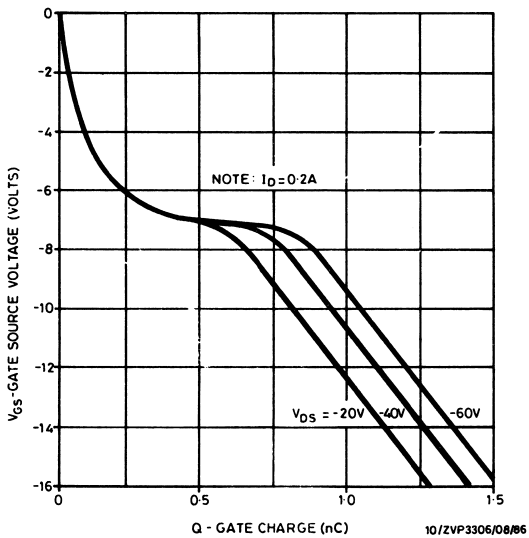


Fig 10. Typical gate charge v gate-source voltage

PNP silicon planar high voltage transistor

BSS63

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Collector-Base Voltage	V_{CBO}	−110	V
Collector-Emitter Voltage	V_{CEO}	−100	V
Emitter-Base Voltage	V_{EBO}	−6	V
Collector Current	I_C	100	mA

CHARACTERISTICS (at 25°C ambient temperature unless otherwise stated).

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
Collector-base breakdown voltage	$V_{(BR)CBO}$	−110	—	—	V	$I_C = 10\mu A$
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	−100	—	—	V	$I_C = 100\mu A$
Emitter-base breakdown voltage	$V_{(BR)EBO}$	−6	—	—	V	$I_E = 10\mu A$
Collector cut-off currents	I_{CBO}	—	—	100	nA	$V_{CB} = 90V$, $I_E = 0$
		—	—	50	μA	$V_{CB} = 90V$, $I_E = 0$ $T_j = 150°C$
	I_{EBO}	—	—	200	nA	$V_{EB} = 6V$, $I_C = 0$
Static forward current transfer ratio	h_{FE}	30 30	— —	— —		$I_C = 10mA$, $V_{CE} = 1V$ $I_C = 25mA$, $V_{CE} = 1V$
Collector-emitter saturation voltage	$V_{CE(sat)}$	—	—	250	mV	$I_C = 25mA$, $I_B = 2.5mA$
Base-emitter saturation voltage	$V_{BE(sat)}$	—	—	900	mV	$I_C = 25mA$, $I_B = 2.5mA$
Output capacitance	C_{obo}	—	3	—	pF	$V_{CB} = 10V$, $I_E = 0$ $f = 1MHz$
Transition frequency	f_T	50	85	—	MHz	$V_{CE} = 5V$, $I_C = 25mA$ $f = 35MHz$

Devices are identified by a code on the body of the device

BSS63 . . . . . T3
BSS63R T6

NPN silicon planar high voltage transistor

BSS64

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Collector-Base Voltage	V_{CBO}	120	V
Collector-Emitter Voltage	V_{CEO}	80	V
Emitter-Base Voltage	V_{EBO}	5	V
Collector Current	I_C	100	mA

CHARACTERISTICS (at 25°C ambient temperature unless otherwise stated).

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
Collector-base breakdown voltage	$V_{(BR)CBO}$	120	—	—	V	$I_C = 100\mu A$
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	80	—	—	V	$I_C = 4mA$
Emitter-base breakdown voltage	$V_{(BR)EBO}$	5	—	—	V	$I_E = 100\mu A$
Collector cut-off currents	I_{CBO}	—	—	100	nA	$V_{CB} = 90V$, $I_E = 0$
		—	—	50	μA	$V_{CB} = 90V$, $I_E = 0$ $T_j = 150°C$
	I_{EBO}	—	—	200	nA	$V_{EB} = 5V$, $I_C = 0$
Static forward current transfer ratio	h_{FE}	— 20 —	60 80 55	— — —		$I_C = 1mA$, $V_{CE} = 1V$ $I_C = 10mA$, $V_{CE} = 1V$ $I_C = 20mA$, $V_{CE} = 1V$
Collector-emitter saturation voltage	$V_{CE(sat)}$	— —	— —	150 200	mV mV	$I_C = 4mA$, $I_B = 400\mu A$ $I_C = 50mA$, $I_B = 15mA$
Base-emitter saturation voltage	$V_{BE(sat)}$	—	—	1.2	V	$I_C = 4mA$, $I_B = 400\mu A$
Output capacitance	C_{obo}	—	3	5	pF	$V_{CB} = 10V$, $I_E = 0$ $f = 1MHz$
Transition frequency	f_T	60	100	—	MHz	$V_{CE} = 10V$, $I_C = 4mA$ $f = 35MHz$

Devices are identified by a code on the body of the device

BSS64 . . . . . U3
BSS64R U6

PNP silicon planar high speed switching transistor

BSS65

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	BSS65	Unit
Collector-Base Voltage	V_{CBO}	−12	V
Collector-Emitter Voltage	V_{CEO}	−12	V
Emitter-Base Voltage	V_{EBO}	−4	V
Collector Current	I_C	−100	mA
Peak Collector Current (10ns)	I_{CM}	−200	mA
Base Current	I_B	−50	mA

CHARACTERISTICS (at 25°C ambient temperature unless otherwise stated).

Parameter	Symbol	BSS65			Unit	Test Conditions
		Min.	Typ.	Max.		
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	−12	—	—	V	$I_C = -10mA$
Collector-base breakdown voltage	$V_{(BR)CBO}$	−12	—	—	V	$I_C = -10\mu A$
Emitter-base breakdown voltage	$V_{(BR)EBO}$	−4	—	—	V	$I_E = -10\mu A$
Collector base cut-off current	I_{CBO}	—	—	−100	nA	$V_{CB} = -6V$, $I_E = 0$
Emitter-base cut-off current	I_{EBO}	—	—	−100	nA	$V_{EB} = -4V$, $I_C = 0$
Collector-emitter saturation voltage	$V_{CE(sat)}$	— —	— —	−0.15 −0.25	V V	$I_C = -10mA$, $I_B = -1mA$ $I_C = -30mA$, $I_B = -3mA$
Base-emitter saturation voltage	$V_{BE(sat)}$	−0.75 −0.82	— —	−0.98 −1.20	V V	$I_C = -10mA$, $I_B = -1mA$ $I_C = -30mA$, $I_B = -3mA$
Static forward current transfer ratio	h_{FE}	30 40	— —	— 150		$I_C = -10mA$, $V_{CE} = -0.3V$ $I_C = -30mA$, $V_{CE} = -0.5V$
Transition frequency	f_T	400	—	—	MHz	$I_C = -30mA$, $V_{CE} = -10V$ $f = 100MHz$
Collector-base capacitance	C_{cbo}	—	—	6	pF	$V_{CB} = -5V$, $I_E = 0$ $f = 1MHz$
Emitter-base capacitance	C_{ebo}	—	—	6	pF	$V_{EB} = -0.5V$, $I_C = 0$ $f = 1MHz$
Switching times Turn-on time Turn-off time	 t_{on} t_{off}	 — —	 23 34	 60 90	 ns ns	 $I_C = -30mA$ $I_{B1} = I_{B2} = -1.5mA$

Devices are identified by a code on the body of the device

BSS65	L1
BSS65R	L5

NPN silicon planar medium power switching transistors

BSS66
BSS67

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	BSS66 & BSS67	Unit
Collector-Base Voltage	V_{CBO}	60	V
Collector-Emitter Voltage	V_{CEO}	40	V
Emitter-Base Voltage	V_{EBO}	6	V
Collector Current	I_C	100	mA
Peak Collector Current (10ms)	I_{CM}	200	mA
Base Current	I_B	50	mA

CHARACTERISTICS (at 25°C ambient temperature unless otherwise stated).

Parameter		Symbol	BSS66 & BSS67 Min.	Typ.	Max.	Unit	Test Conditions
Collector-emitter breakdown voltage		$V_{(BR)CEO}$	40	—	—	V	I_C=1mA
Collector-base breakdown voltage		$V_{(BR)CBO}$	60	—	—	V	I_C=10μA
Emitter-base breakdown voltage		$V_{(BR)EBO}$	6	—	—	V	I_E=10μA
Collector-emitter cut-off current		I_{CES}	—	—	50	nA	V_{CES}=30V
Collector-emitter saturation voltage		$V_{CE(sat)}$	— —	— —	0.20 0.30	V V	I_C=10mA, I_B=1mA I_C=50mA, I_B=5mA
Base-emitter saturation voltage		$V_{BE(sat)}$	0.65 —	— —	0.85 0.95	V V	I_C=10mA, I_B=1mA I_C=50mA, I_B=5mA
Static forward current transfer ratio	BSS66	h_{FE}	20 35 50 30 15	— — — — —	— — 150 — —		I_C=100μA I_C=1mA I_C=10mA I_C=50mA I_C=100mA } V_{CE}=1V
	BSS67	h_{FE}	40 70 100 60 30	— — — — —	— — 300 — —		I_C=100μA I_C=1mA I_C=10mA I_C=50mA I_C=100mA } V_{CE}=1V
Transition frequency	BSS66	f_T	250	—	—	MHz	I_C=10mA, V_{CE}=20V, f=100MHz
	BSS67		300	—	—	MHz	
Collector-base capacitance		C_{cbo}	—	—	4.0	pF	V_{CB}=5V, f=100kHz

CHARACTERISTICS (Continued).

Parameter	Symbol	BSS66 & BSS67			Unit	Test Conditions
		Min.	Typ.	Max.		
Emitter-base capacitance	C_{ebo}	—	—	8	pF	$V_{EB}=0.5V$, f=100kHz
Noise figure	N	—	6	—	dB	$I_C=100\mu A$, $V_{CE}=5V$ $R_S=1k\Omega$, f=10Hz to 15.7kHz
Switching times						
Delay time	t_d	—	—	35	ns	$V_{CC}=3V$, $I_C=10mA$ $I_{B1}=I_{B2}=1mA$
Rise time	t_r	—	—	35	ns	
Storage time	t_s	—	—	200	ns	
Fall time	t_f	—	—	50	ns	

Devices are identified by a code on the body of the device

BSS66	M6
BSS67	M7
BSS66R	M8
BSS67R	M9

PNP silicon planar medium power switching transistors

BSS69
BSS70

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	BSS69 & BSS70	Unit
Collector-Base Voltage	V_{CBO}	−40	V
Collector-Emitter Voltage	V_{CEO}	−40	V
Emitter-Base Voltage	V_{EBO}	−5	V
Collector Current	I_C	−100	mA
Peak Collector Current (10ms)	I_{CM}	−200	mA
Base Current	I_B	−50	mA

CHARACTERISTICS (at 25°C ambient temperature unless otherwise stated).

Parameter		Symbol	BSS69 & BSS70 Min.	Typ.	Max.	Unit	Test Conditions
Collector-emitter breakdown voltage		$V_{(BR)CEO}$	−40	—	—	V	$I_C = -1\,mA$
Collector-base breakdown voltage		$V_{(BR)CBO}$	−40	—	—	V	$I_C = -10\,\mu A$
Emitter-base breakdown voltage		$V_{(BR)EBO}$	−5	—	—	V	$I_E = -10\,\mu A$
Collector-emitter cut-off current		I_{CES}	—	—	−50	nA	$V_{CES} = -30V$
Collector-emitter saturation voltage		$V_{CE(sat)}$	— —	— —	−0.25 −0.40	V V	$I_C = -10\,mA$, $I_B = -1\,mA$ $I_C = -50\,mA$, $I_B = -5\,mA$
Base-emitter saturation voltage		$V_{BE(sat)}$	−0.65 —	— —	−0.85 −0.95	V V	$I_C = -10\,mA$, $I_B = -1\,mA$ $I_C = -50\,mA$, $I_B = -5\,mA$
Static forward current transfer ratio	BSS69	h_{FE}	30 40 50 30 15	— — — — —	— — 150 — —		$I_C = -100\,\mu A$ $I_C = -1\,mA$ $I_C = -10\,mA$ $I_C = -50\,mA$ $I_C = -100\,mA$ } $V_{CE} = -1V$
	BSS70	h_{FE}	60 80 100 60 30	— — — — —	— — 300 — —		$I_C = -100\,\mu A$ $I_C = -1\,mA$ $I_C = -10\,mA$ $I_C = -50\,mA$ $I_C = -100\,mA$ } $V_{CE} = -1V$
Transition frequency	BSS69	f_T	200	—	—	MHz	} $I_C = -10\,mA$, $V_{CE} = -20V$, $f = 100\,MHz$
	BSS70		250	—	—	MHz	
Collector-base capacitance		C_{cbo}	—	—	4.5	pF	$V_{CB} = -5V$, $f = 100\,kHz$

CHARACTERISTICS (Continued).

Parameter	Symbol	BSS69 & BSS70			Unit	Test Conditions
		Min.	Typ.	Max.		
Emitter-base capacitance	C_{ebo}	—	—	10	pF	$V_{EB} = -0.5V$, f=100kHz
Noise figure	N	—	5	—	dB	$I_C = -100\mu A$, $V_{CE} = -5V$ $R_S = 1k\Omega$, f=10Hz to 15.7kHz
Switching times						
Delay time	t_d	—	—	35	ns	$V_{CC} = -3V$, $I_C = -10mA$ $I_{B1} = I_{B2} = -1mA$
Rise time	t_r	—	—	35	ns	
Storage time	t_s	—	—	225	ns	
Fall time	t_f	—	—	75	ns	

Devices are identified by a code on the body of the device

BSS69	L2
BSS70	L3
BSS69R	L6
BSS70R	L7

NPN silicon planar general purpose switching transistors

BSS79B
BSS79C

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	BSS79B, C	Unit
Collector-Base Voltage	V_{CBO}	75	V
Collector-Emitter Voltage	V_{CEO}	40	V
Emitter-Base Voltage	V_{EBO}	6	V
Peak Collector Current	I_{CM}	800	mA

CHARACTERISTICS (at 25°C ambient temperature unless otherwise stated).

Parameter	Symbol	Min.	Max.	Unit	Conditions
Collector-base breakdown voltage	$V_{(BR)CBO}$	75	—	V	$I_C = 10\mu A$
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	40	—	V	$I_C = 10mA$
Emitter-base breakdown voltage	$V_{(BR)EBO}$	6	—	V	$I_E = 10\mu A$
Collector-base cut-off current	I_{CBO}	— —	10 10	nA μA	$V_{CB} = 60V$ $V_{CB} = 60V$, $T_A = 150°C$
Emitter-base cut-off current	I_{EBO}	—	10	nA	$V_{BE} = 3.0V$
Collector-emitter saturation voltage	$V_{CE(sat)}$	— —	0.3 1.0	V V	$I_C = 150mA$, $I_B = 15mA$ $I_C = 500mA$, $I_B = 50mA$
Static forward current transfer ratio **BSS79B** **BSS79C**	h_{FE}	40 100	120 300		$I_C = 150mA$, $V_{CE} = 10V$ $I_C = 150mA$, $V_{CE} = 10V$
Transition frequency	f_T	250	—	MHz	$V_{CE} = 20V$, $I_C = 20mA$ $f = 100MHz$
Collector-base capacitance	C_{cbo}	—	8	pF	$V_{CB} = 10V$, $f = 1MHz$

SWITCHING CHARACTERISTICS (at 25°C ambient temperature).

Parameter	Symbol	Min.	Max.	Unit	Conditions
Delay time	t_d	—	10	ns	$V_{CC}=30V$, $I_C=150mA$ $I_{B1}=I_{B2}=15mA$
Rise time	t_r	—	10	ns	
Storage time	t_s	—	225	ns	$V_{CC}=30V$, $I_C=150mA$ $I_{B1}=I_{B2}=15mA$
Fall time	t_f	—	60	ns	

Devices are identified by a code on the body of the device

BSS79B . . . . . CE
BSS79C . . . . . CF

PNP silicon planar general purpose switching transistors

BSS80B
BSS80C

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	BSS80B, C	Unit
Collector-Base Voltage	V_{CBO}	60	V
Collector-Emitter Voltage	V_{CEO}	40	V
Emitter-Base Voltage	V_{EBO}	5	V
Peak Collector Current	I_{CM}	800	mA

CHARACTERISTICS (at $T_{amb} = 25°C$ unless otherwise stated).

Parameter		Symbol	Min.	Max.	Unit	Conditions
Collector-base breakdown voltage		$V_{(BR)CBO}$	60	—	V	$I_C = 10\mu A$
Collector-emitter breakdown voltage		$V_{(BR)CEO}$	40	—	V	$I_C = 10mA$
Emitter-base breakdown voltage		$V_{(BR)EBO}$	5	—	V	$I_E = 10\mu A$
Collector-base cut-off current		I_{CBO}	— —	10 10	nA μA	$V_{CB} = 50V$ $V_{CB} = 50V$, $T_A = 150°C$
Emitter-base cut-off current		I_{EBO}	—	10	nA	$V_{EB} = 3V$
Collector-emitter saturation voltage		$V_{CE(sat)}$	— —	0.4 1.6	mV V	$I_C = 150mA$, $I_B = 15mA$ $I_C = 500mA$, $I_B = 50mA$
Static forward current transfer ratio	**BSS80B**	h_{FE}	40	120		$I_C = 150mA$, $V_{CE} = 10V$
	BSS80C		100	300		$I_C = 150mA$, $V_{CE} = 10V$
Transition frequency		f_T	200	—	MHz	$V_{CE} = 20V$, $I_C = 50mA$ $f = 100MHz$
Collector-base capacitance		C_{cbo}	—	8	pF	$V_{CB} = 10V$, $f = 1MHz$

SWITCHING CHARACTERISTICS (at 25°C ambient temperature).

Parameter	Symbol	Min.	Max.	Unit	Conditions
Delay time	t_d	–	10	ns	$V_{CC}=30V$, $I_C=150mA$ $I_{B1}=I_{B2}=15mA$
Rise time	t_r	–	40	ns	
Storage time	t_s	–	80	ns	$V_{CC}=30V$, $I_C=150mA$ $I_{B1}=I_{B2}=15mA$
Fall time	t_f	–	30	ns	

Devices are identified by a code on the body of the device

BSS80B . . . . . CH
BSS80C . . . . . CJ

PNP silicon planar general purpose switching transistors

BSS82B
BSS82C

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	BSS82B, C	Unit
Collector-Base Voltage	V_{CBO}	60	V
Collector-Emitter Voltage	V_{CEO}	60	V
Emitter-Base Voltage	V_{EBO}	5	V
Peak Collector Current	I_{CM}	800	mA

CHARACTERISTICS (at $T_j = 25°C$ unless otherwise stated).

Parameter	Symbol	Min.	Max.	Unit	Conditions
Collector-base breakdown voltage	$V_{(BR)CBO}$	60	–	V	$I_C = 10\mu A$
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	60	–	V	$I_C = 10mA$
Emitter-base breakdown voltage	$V_{(BR)EBO}$	5	–	V	$I_E = 10\mu A$
Collector-base cut-off current	I_{CBO}	– –	10 10	nA μA	$V_{CB} = 50V$ $V_{CB} = 50V$, $T_A = 150°C$
Emitter-base cut-off current	I_{EBO}	–	10	nA	$V_{EB} = 3V$
Collector-emitter saturation voltage	$V_{CE(sat)}$	– –	0.4 1.6	mV V	$I_C = 150mA$, $I_B = 15mA$ $I_C = 500mA$, $I_B = 50mA$
Static forward current transfer ratio **BSS82B**	h_{FE}	40	120		$I_C = 150mA$, $V_{CE} = 10V$
BSS82C		100	300		$I_C = 150mA$, $V_{CE} = 10V$
Transition frequency	f_T	200	–	MHz	$V_{CE} = 20V$, $I_C = 50mA$ $f = 100MHz$
Collector-base capacitance	C_{cbo}	–	8	pF	$V_{CB} = 10V$, $f = 1MHz$

SWITCHING CHARACTERISTICS (at 25°C ambient temperature).

Parameter	Symbol	Min.	Max.	Unit	Conditions
Delay time	t_d	—	10	ns	V_{CC}=30V, I_C=150mA $I_{B1}=I_{B2}$=15mA
Rise time	t_r	—	40	ns	
Storage time	t_s	—	80	ns	V_{CC}=30V, I_C=150mA $I_{B1}=I_{B2}$=15mA
Fall time	t_f	—	30	ns	

Devices are identified by a code on the body of the device

BSS82B CL
BSS82C . . . . . CM

P-Channel enhancement mode vertical DMOS FET

PROVISIONAL DATA

BSS84

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Drain-Source Voltage	V_{DS}	−50	V
Continuous Drain Current	I_D	−130	mA
Pulsed Drain Current	I_{DM}	−520	mA
Gate-Source Peak Voltage	V_{GS}	±20	V

ELECTRICAL CHARACTERISTICS (at T_{amb} = 25°C unless otherwise stated).

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
Drain-source breakdown voltage	BV_{DSS}	−50	—	—	V	V_{GS} = 0V I_D = −0.25mA
Gate-source threshold voltage	$V_{GS(th)}$	−0.8	−1.5	−2.0	V	V_{DS} = V_{GS} I_D = −1mA
Zero gate voltage drain current	I_{DSS}	— —	−1 −2	−15 −60	μA μA	T_j = 25°C T_j = 125°C V_{DS} = −50V, V_{GS} = 0V (2)
		—	—	−100	nA	T_j = 25°C V_{DS} = −25V, V_{GS} = 0V
Gate-source leakage current	I_{GSS}	—	−1	−10	nA	V_{GS} = ±20V V_{DS} = 0V
Drain-source on-state resistance (1)	$R_{DS(on)}$	—	6	10	Ω	V_{GS} = −5V I_D = −100mA
Forward transconductance (1) (2)	g_{fs}	0.05	0.07	—	S	V_{DS} = −25V I_D = −100mA
Input capacitance (2)	C_{iss}	—	40	—	pF	V_{GS} = 0V
Output capacitance (2)	C_{oss}	—	15	—		V_{DS} = −25V
Reverse transfer capacitance (2)	C_{rss}	—	6	—		f = 1MHz
Turn-on time t_{on}	$t_{d(on)}$	—	10	—	ns	V_{DD} = −30V
($t_{on} = t_{d(on)} + t_r$) (2)	t_r	—	10	—		I_D = −0.27A
Turn-off time t_{off}	$t_{d(off)}$	—	18	—		V_{GS} = −5V
($t_{off} = t_{d(off)} + t_f$) (2)	t_f	—	25	—		R_{GS} = 50Ω

Notes (1) Measured under pulsed conditions. Width = 300μs. Duty cycle ⩽ 2%.
(2) Sample test.

Devices are identified by a code on the body of the device

BSS84 . . . . . SP

N-Channel enhancement mode vertical DMOS FET

BSS123

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	BSS123	Unit
Drain-Source Voltage	V_{DS}	100	V
Drain-gate Voltage	V_{DGR}	100	V
Continuous Drain Current at $T_{amb} = 25°C$	I_D	170	mA
Pulsed Drain Current	I_{DM}	0.68	A
Gate-Source Voltage	V_{GS}	±10	V
Peak Gate-source Voltage	V_{GSM}	±20	V

ELECTRICAL CHARACTERISTICS (at $T_{amb} = 25°C$ unless otherwise stated)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
Drain-Source breakdown voltage	BV_{DSS}	100	–	–	V	$I_D = 0.25mA$, $V_{GS} = 0V$
Gate-Source threshold voltage	$V_{GS(th)}$	0.8	2.2	2.8	V	$I_D = 1mA$, $V_{DS} = V_{GS}$
Zero Gate voltage drain current	I_{DSS}	– – –	1 2 –	15 60 10	μA μA nA	$V_{DS}=100V$, $V_{GS}=0V$, $T=25°C$ $V_{DS}=100V$, $V_{GS}=0V$, $T=125°C$ $V_{DS}=20V$, $V_{GS}=0V$, $T=25°C$
Gate-Body leakage	I_{GSS}	–	10	50	nA	$V_{GS} = 20V$, $V_{DS} = 0V$
Static Drain-Source on-state resistance (1)	$R_{DS(on)}$	–	5	6	Ω	$I_D = 100mA$, $V_{GS} = 10V$
Forward transconductance (1) and (2)	g_{fs}	80	120	–	mS	$V_{DS} = 25V$, $I_D = 100mA$
Input capacitance (2)	C_{iss}	–	20	–	pF	$V_{DS} = 25V$, $V_{GS} = 0V$ $f = 1MHz$
Common source output capacitance (2)	C_{oss}	–	9	–	pF	
Reverse transfer capacitance (2)	C_{rss}	–	4	–	pF	

ELECTRICAL CHARACTERISTICS (continued)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
Turn-on delay time (2) (3)	$t_{d(on)}$	–	10	–	ns	V_{DD} = 30V, I_D = 280mA
Rise time (2) (3)	t_r	–	10	–	ns	
Turn-off delay time (2) (3)	$t_{d(off)}$	–	15	–	ns	
Fall time (2) (3)	t_f	–	25	–	ns	

Reverse Diode	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
Continuous reverse drain current	I_{DR}	–	–	0.17	A	@T_A = 25°C
Pulsed reverse drain current	I_{DRM}	–	–	0.68	A	@T_A = 25°C
Diode forward on-voltage	V_{SD}	–	1.1	1.3	V	$I_F = 2 \times I_{DR}$, V_{GS} = 0V, T = 25°C

Notes (1) Measured under pulsed conditions. Width = 300μs. Duty cycle ⩽ 2%.
(2) Sample test.
(3) Switching times measured with 50Ω source impedance and < 5ns rise time on a pulse generator.

Devices are identified by a code on the body of the device

BSS123 . . . . . SA

N-Channel enhancement mode vertical DMOS FET

PROVISIONAL DATA

BSS138

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Drain-Source Voltage	V_{DS}	50	V
Continuous Drain Current at $T_{amb} = 25°C$	I_D	0.2	A
Pulsed Drain Current	I_{DM}	0.8	A
Gate-Source Voltage	V_{GS}	±20	V

ELECTRICAL CHARACTERISTICS (at $T_{amb} = 25°C$ unless otherwise stated)

Parameter	Symbol	Min.	Max.	Unit	Test Conditions
Drain-Source breakdown voltage	BV_{DSS}	50	—	V	$I_D = 250\mu A$, $V_{GS} = 0V$
Gate-Source threshold voltage	$V_{GS(th)}$	0.5	1.5	V	$I_D = 1mA$, $V_{DS} = V_{GS}$
Gate-Body leakage	I_{GSS}	—	100	nA	$V_{GS} = 20V$, $V_{DS} = 0V$
Zero Gate voltage drain current	I_{DSS}	— — —	0.5 5 100	μA μA nA	$V_{DS} = 50V$, $V_{GS} = 0V$, $T = 25°C$ $V_{DS} = 50V$, $V_{GS} = 0V$, $T = 125°C$ $V_{DS} = 25V$, $V_{GS} = 0V$, $T = 25°C$
Static Drain-Source on-state resistance (1)	$R_{DS(on)}$	—	3.5	Ω	$I_D = 0.2A$, $V_{GS} = 5V$
Forward transconductance (1) (2)	g_{fs}	120	—	mS	$V_{DS} = 25V$, $I_D = 0.2A$
Input capacitance (2)	C_{iss}	—	50	pF	$V_{DS} = 25V$, $V_{GS} = 0V$ $f = 1MHz$
Common source output capacitance (2)	C_{oss}	—	25	pF	
Reverse transfer capacitance (2)	C_{rss}	—	8	pF	

ELECTRICAL CHARACTERISTICS (continued)

Parameter	Symbol	Min.	Max.	Unit	Test Conditions
Turn-on delay time (2) (3)	$t_{d(on)}$	–	8	ns	$V_{DD} = 30V$, $I_D = 290mA$
Rise time (2) (3)	t_r	–	8	ns	
Turn-off delay time (2) (3)	$t_{d(off)}$	–	16	ns	
Fall time (2) (3)	t_f	–	25	ns	

Notes (1) Measured under pulsed conditions. Width = 300μs. Duty cycle ⩽ 2%.
(2) Sample test.
(3) Switching times measured with 50Ω source impedance and < 5ns rise time on a pulse generator.

Devices are identified by a code on the body of the device

BSS138 . . . . . SS

NPN silicon planar high speed switching transistor

BSV52

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	BSV52	Unit
Collector-Base Voltage	V_{CBO}	20	V
Collector-Emitter Voltage	V_{CES}	20	V
Collector-Emitter Voltage (I_C=10mA)	V_{CEO}	12	V
Emitter-Base Voltage	V_{EBO}	5.0	V
Collector Current	I_C	100	mA
Peak Collector Current	I_{CM}	200	mA

CHARACTERISTICS (at T_j=25°C unless otherwise stated).

Parameter	Symbol	BSV52			Unit	Test Conditions
		Min.	Typ.	Max.		
Collector base cut-off current	I_{CBO}	—	—	100	nA	I_E=0, V_{CB}=10V
		—	—	5.0	μA	I_E=0, V_{CB}=10V, T_j=125°C
Collector-emitter saturation voltage	$V_{CE(sat)}$	—	—	300	mV	I_C=10mA, I_B=0.3mA
		—	—	250	mV	I_C=10mA, I_B=1.0mA
		—	—	400	mV	I_C=50mA, I_B=5.0mA
Base-emitter saturation voltage	$V_{BE(sat)}$	700	—	850	mV	I_C=10mA, I_B=1.0mA
		—	—	1.2	V	I_C=50mA, I_B=5.0mA
Static forward current transfer ratio	h_{FE}	25	—	—		I_C=1.0mA, V_{CE}=1.0V
		40	—	120		I_C=10mA, V_{CE}=1.0V
		25	—	—		I_C=50mA, V_{CE}=1.0V
Transition frequency	f_T	400	500	—	MHz	I_C=10mA, V_{CE}=10V f=100MHz
Collector capacitance	C_{Tc}	—	—	4.0	pF	I_E=I_e=0, V_{CB}=5.0V f=1.0MHz
Emitter capacitance	C_{Te}	—	—	4.5	pF	I_C=I_c=0, V_{EB}=1.0V f=1.0MHz

SWITCHING CHARACTERISTICS (at 25°C ambient temperature).

Parameter	Symbol	Min.	Max.	Unit	Conditions
Turn-on time	t_{on}	—	12	ns	V_{CC}=3V, $V_{BE(off)}$=1.5V I_C=10mA, I_{B1}=3mA (see Fig. 1)
Turn-off time	t_{off}	—	18	ns	V_{CC}=3V, I_C=10mA, I_{B1}=3mA I_{B2}=1.5mA (see Fig. 2)
Storage time	t_s	—	13	ns	I_{B1}=I_{B2}=I_C=10mA (see fig. 3)

CIRCUITS FOR MEASURING SWITCHING TIMES

TURN-ON TIME

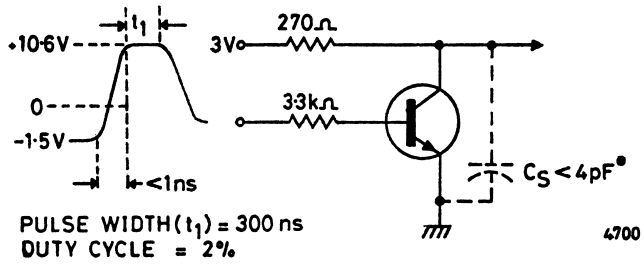


Fig. 1

TURN-OFF TIME

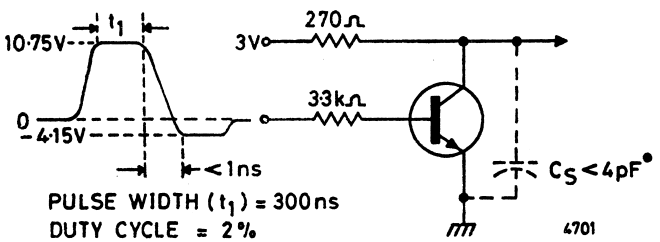


Fig. 2

STORAGE TEST CIRCUIT

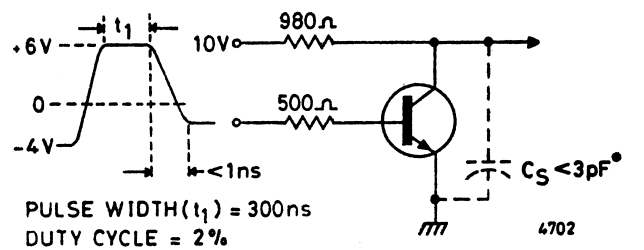


Fig. 3

• **Total Shunt Capacitance of Test Jig and Connectors**

Devices are identified by a code on the body of the device

BSV52 . . . . . B2
BSV52R B4

Silicon voltage regulator diodes

BZX84 Series
C2V7 to C47

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Voltage range	V_Z	2.7 to 47	V
Nominal tolerance	C*	±5	%
Maximum forward current	I_F	250	mA

*As per Pro-Electron coding system.

ELECTRICAL CHARACTERISTICS (at 25°C ambient temperature).

Type Number	Zener Voltage V_Z at I_Z=5mA Volts			Differential Resistance r_z at I_Z=5mA Ohms	Temperature Coefficient S_Z %/100°C		Reverse Current I_R at V_R μA Volts		Diode Capacitance $C_{d(pF)}$ f=1mHz V_R=0
	Nom.	Min.	Max.	Max.	Min.	Max.	Max.		Max.
BZX84-C2V7	2.7	2.5	2.9	100	− 3.5	0	20	1	450
C3V0	3.0	2.8	3.2	100	− 3.5	0	10	1	450
C3V3	3.3	3.1	3.5	100	− 3.5	0	5	1	450
C3V6	3.6	3.4	3.8	100	− 3.5	0	5	1	450
C3V9	3.9	3.7	4.1	100	− 3.5	0	3	1	450
C4V3	4.3	4.0	4.6	90	− 3.5	0	3	1	450
C4V7	4.7	4.4	5.0	80	− 3.5	0.2	3	2	180
C5V1	5.1	4.8	5.4	60	− 2.7	1.2	2	2	160
C5V6	5.6	5.2	6.0	40	− 2.0	2.5	1	2	140
C6V2	6.2	5.8	6.6	10	0.4	3.7	3	4	130
C6V8	6.8	6.4	7.2	15	1.2	4.5	2	4	110
C7V5	7.5	7.0	7.9	15	2.5	5.3	1	5	100
C8V2	8.2	7.7	8.7	15	3.2	6.2	0.7	5	95
C9V1	9.1	8.5	9.6	15	3.8	7.0	0.5	6	90
C10	10	9.4	10.6	20	4.5	8.0	0.2	7	90
C11	11	10.4	11.6	20	5.4	9.0	0.1	8	85
C12	12	11.4	12.7	25	6.0	10.0	0.1	8	85
C13	13	12.4	14.1	30	7.0	11.0	0.1	9	80
C15	15	13.8	15.6	30	9.2	13.0	0.05	10	75
C16	16	15.3	17.1	40	10.4	14.0	0.05	11	75
C18	18	16.8	19.1	45	12.4	16.0	0.05	13	70
C20	20	18.8	21.2	55	14.4	18.0	0.05	14	60
C22	22	20.8	23.3	55	16.4	20.0	0.05	15	60
C24	24	22.8	25.6	70	18.4	22.0	0.05	17	55
BZX84	V_Z at I_Z=2mA			r_z at I_Z=2mA	S_Z at I_Z=2mA				
C27	27	25.1	28.9	80	21.4	25.3	0.05	19	50
C30	30	28	32	80	24.4	29.4	0.05	21	50
C33	33	31	35	80	27.4	33.4	0.05	23	45
C36	36	34	38	90	30.4	37.4	0.05	25	45
C39	39	37	41	130	33.4	41.2	0.05	27	45
C43	43	40	46	150	37.6	46.6	0.05	30	40
C47	47	44	50	170	42.0	51.8	0.05	33	40

ELECTRICAL CHARACTERISTICS (at 25°C ambient temperature).

Type Number	Zener Voltage V_Z at $I_Z = 1mA$ Volts Min.	Differential Resistance r_Z at $I_Z = 1$ Ohms Max.
BZX84		
C2V7	1.9	600
C3V0	2.1	600
C3V3	2.4	600
C3V6	2.7	600
C3V9	3.0	600
C4V3	3.3	600
C4V7	3.7	500
C5V1	4.2	480
C5V6	4.8	400
C6V2	5.6	150
C6V8	6.3	80
C7V5	6.9	80
C8V2	7.6	80
C9V1	8.4	100
C10	9.3	150
C11	10.2	150
C12	11.2	150
C13	12.3	170
C15	13.7	200
C16	15.2	200
C18	16.7	225
C20	18.7	225
C22	20.7	250
C24	22.7	250
BZX84	V_Z at $I_Z = 0.5mA$	r_Z at $I_Z = 0.5mA$
C27	25.0	300
C30	27.8	300
C33	30.8	325
C36	33.8	350
C39	36.7	350
C43	39.7	375
C47	43.7	375

PIN CONFIGURATION

6353

Devices are identified by a code on the body of the device

Device	Device Code
BZX84-C2V7	W4
C3V0	W5
C3V3	W6
C3V6	W7
C3V9	W8
C4V3	W9
C4V7	Z1
C5V1	Z2
C5V6	Z3
C6V2	Z4
C6V8	Z5
C7V5	Z6
C8V2	Z7
C9V1	Z8
C10	Z9
C11	Y1
C12	Y2
C13	Y3
C15	Y4
C16	Y5
C18	Y6
C20	Y7
C22	Y8
C24	Y9
C27	X1
C30	X2
C33	X3
C36	X4
C39	X5
C43	X6
C47	X7

High speed switching diode

FMMD914

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Working peak reverse voltage	V_{RWM}	75	V
Average rectified forward current at 25°C	$I_{F(AV)}$	75	mA
Repetitive peak forward current	I_{FRM}	225	mA

CHARACTERISTICS (at 25°C ambient unless otherwise specified).

Parameter	Symbol	Min.	Max.	Unit	Test conditions
Reverse breakdown voltage	V_{BR}	100	–	V	$I_R = 100\mu A$
Static reverse current	I_R	– –	25 50	nA μA	$V_R = 20V$ $V_R = 20V$, $T_{amb} = 150°C$
Static forward voltage	V_F	–	1	V	$I_F = 10mA$
Total capacitance	C_T	–	4	pF	$V_R = 0$, f = 1MHz
Reverse recovery time	t_{rr}	–	8	ns	$I_F = 10mA$, $I_{RM} = 10mA$ $i_{rr} = 1mA$, $R_L = 100\Omega$ (See Fig. 1, Condition 1)
		–	4	ns	$I_F = 10mA$, $V_R = 6V$ $i_{rr} = 1mA$, $R_L 100\Omega$ (See Fig. 1, Condition 2)
Forward recovery voltage	$V_{FM(rec)}$	–	2.5	V	$I_F = 50mA$, $R_L = 50\Omega$ (See Fig. 2)
Rectification efficiency	η_r	45	–	%	$V_r = 2V$, $R_L = 5k\Omega$ $C_L = 20pF$, $Z_{source} = 50\Omega$ f = 100MHz

PARAMETER MEASUREMENT INFORMATION

Circuit for measuring switching time

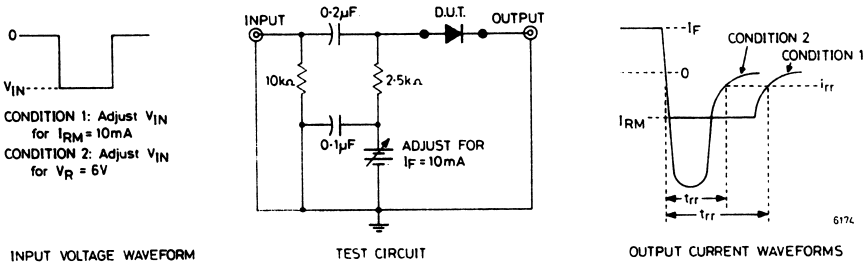


Fig. 1 reverse recovery time

NOTE 1:
The input pulse is supplied by a generator with the following characteristics:
$Z_{OUT} = 50\Omega$, $t_r \leqslant 0.5$ns, $t_W = 100$ns.

NOTE 2:
Output waveforms are monitored on an oscilloscope with the following characteristics:
$t_r \leqslant 0.6$ns, $Z_{IN} = 50\Omega$.

Circuit for measuring switching time

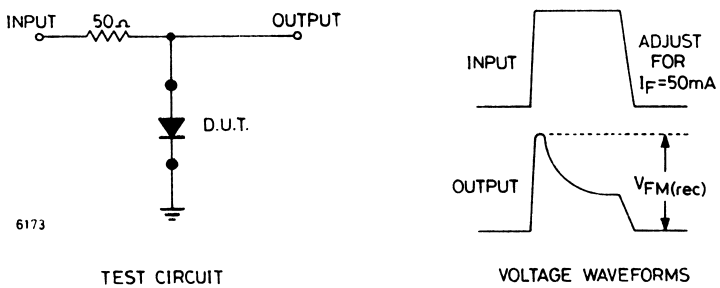


Fig. 2 forward recovery voltage

NOTE 3:
The input pulse is supplied by a generator with the following characteristics:
$Z_{OUT} = 50\Omega$, $t_r \leqslant 30$ns, $t_W = 100$ns, PRR = 5 to 100kHz.

NOTE 4:
The output waveform is monitored on an oscilloscope with the following characteristics:
$t_r \leqslant 15$ns, $R_{IN} \geqslant 1M\Omega$, $C_{IN} \geqslant 5$pF.

PIN CONFIGURATION

6175

Devices are identified by a code on the body of the device

FMMD914 . . . . . 5D

High speed switching diode pair common anode

FMMD2835

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	FMMD2835	Unit
Breakdown voltage at $I_R = 100\mu A$	$V_{(BR)}$	35	V
Average rectified forward current (over any 20ms period)	$I_{F(AV)}$	100	mA
Repetitive peak forward current	I_{FRM}	200	mA

CHARACTERISTICS (at $T_{amb} = 25°C$ unless otherwise specified).

Parameter	Symbol	Max.	Unit	Test conditions
Forward voltage	V_F	1.0 1.0 1.2	V V V	$I_F = 10mA$ $I_F = 50mA$ $I_F = 100mA$
Reverse current	I_R	100	nA	$V_R = 30V$
Diode capacitance	C_d	4.0	pF	$V_R = 0$, f = 1MHz
Reverse recovery time	t_{rr}	6.0	ns	$I_F = I_R = 10mA$, $i_{R(REC)} = 1.0mA$ (Fig. 1)

SWITCHING TIME TEST DATA

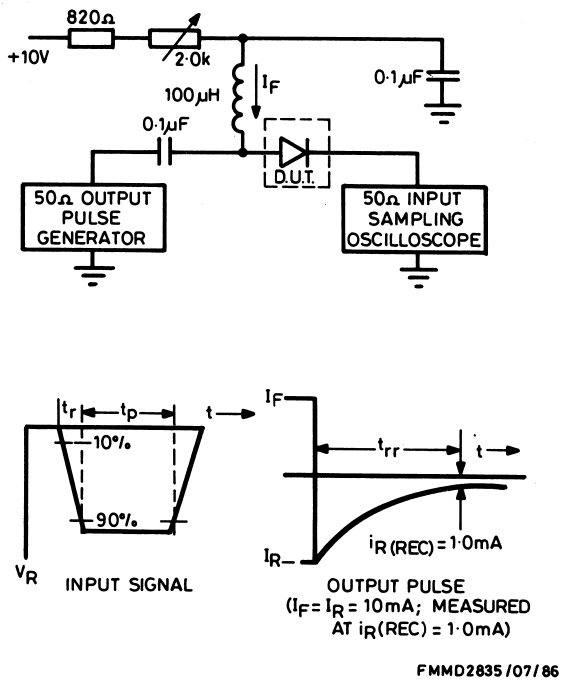
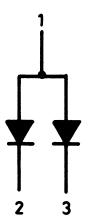


Fig. 1 Recovery time equivalent test circuit

NOTES:
1. A 2.0kΩ variable resistor adjusted for a forward current (V_F) of 10mA.
2. Input pulse is adjusted so $I_{R(peak)}$ is equal to 10mA.
3. $t_p \gg t_{rr}$

PIN CONFIGURATION



FMMD2835/07/86

Devices are identified by a code on the body of the device

FMMD2835 . . . . . A9

High speed switching diode pair common anode

FMMD2836

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	FMMD2836	Unit
Breakdown voltage at $I_R = 100\mu A$	$V_{(BR)}$	75	V
Average rectified forward current (over any 20ms period)	$I_{F(AV)}$	100	mA
Repetitive peak forward current	I_{FRM}	200	mA

CHARACTERISTICS (at $T_{amb} = 25°C$ unless otherwise specified).

Parameter	Symbol	Max.	Unit	Test conditions
Forward voltage	V_F	1.0 1.0 1.2	V V V	$I_F = 10mA$ $I_F = 50mA$ $I_F = 100mA$
Reverse current	I_R	100	nA	$V_R = 30V$
Diode capacitance	C_d	4.0	pF	$V_R = 0$, f = 1MHz
Reverse recovery time	t_{rr}	6.0	ns	$I_F = I_R = 10mA$, $i_{R(REC)} = 1.0mA$ (Fig. 1)

SWITCHING TIME TEST DATA

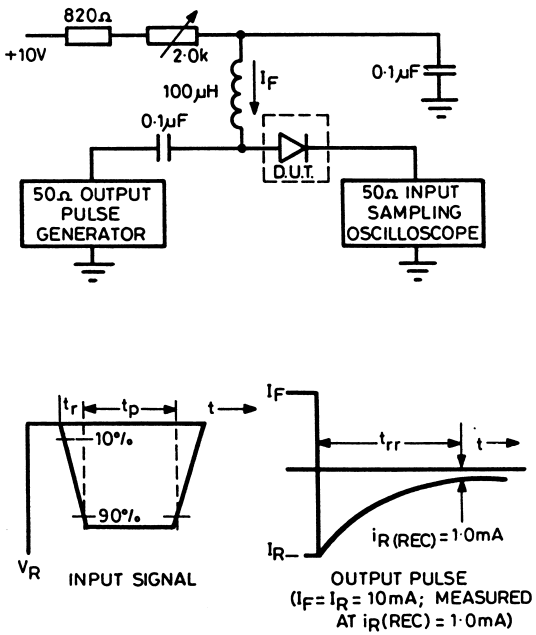
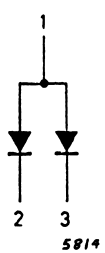


Fig. 1 Recovery time equivalent test circuit

NOTES:
1. A 2.0kΩ variable resistor adjusted for a forward current (V_F) of 10mA.
2. Input pulse is adjusted so $I_{R(peak)}$ is equal to 10mA.
3. $t_p >> t_{rr}$

PIN CONFIGURATION



Devices are identified by a code on the body of the device

FMMD2836 . . . . . A2

High speed switching diode pair common cathode

FMMD2837

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	FMMD2837	Unit
Breakdown voltage at $I_R = 100\mu A$	$V_{(BR)}$	35	V
Average rectified forward current (over any 20ms period)	$I_{F(AV)}$	100	mA
Repetitive peak forward current	I_{FRM}	200	mA

CHARACTERISTICS (at $T_{amb} = 25°C$ unless otherwise specified).

Parameter	Symbol	Max.	Unit	Test conditions
Forward voltage	V_F	1.0 1.0 1.2	V V V	$I_F = 10mA$ $I_F = 50mA$ $I_F = 100mA$
Reverse current	I_R	100	nA	$V_R = 30V$
Diode capacitance	C_d	4.0	pF	$V_R = 0$, f = 1MHz
Reverse recovery time	t_{rr}	6.0	ns	$I_F = I_R = 10mA$, $i_{R(REC)} = 1.0mA$ (Fig. 1)

SWITCHING TIME TEST DATA

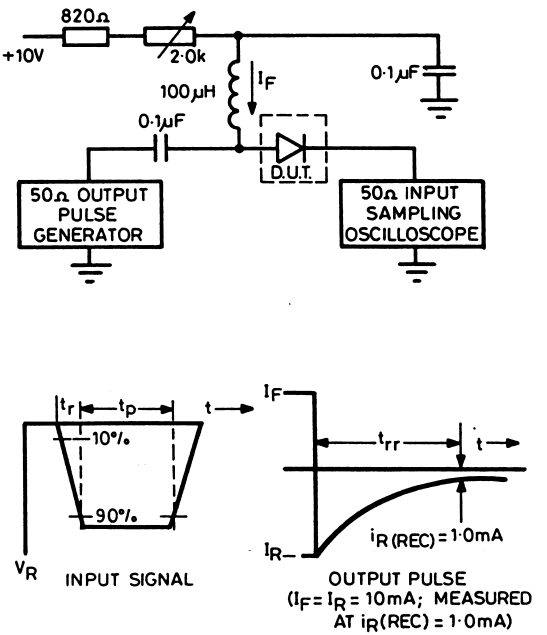
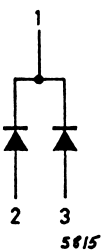


Fig. 1 Recovery time equivalent test circuit

NOTES:
1. A 2.0kΩ variable resistor adjusted for a forward current (V_F) of 10mA.
2. Input pulse is adjusted so $I_{R(peak)}$ is equal to 10mA.
3. $t_p >> t_{rr}$

PIN CONFIGURATION



Devices are identified by a code on the body of the device

FMMD2837 . . . . . A5

High speed switching diode pair common cathode

FMMD2838

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	FMMD2838	Unit
Breakdown voltage at $I_R = 100\mu A$	$V_{(BR)}$	75	V
Average rectified forward current (over any 20ms period)	$I_{F(AV)}$	100	mA
Repetitive peak forward current	I_{FRM}	200	mA

CHARACTERISTICS (at $T_{amb} = 25°C$ unless otherwise specified).

Parameter	Symbol	Max.	Unit	Test conditions
Forward voltage	V_F	1.0 1.0 1.2	V V V	$I_F = 10mA$ $I_F = 50mA$ $I_F = 100mA$
Reverse current	I_R	100	nA	$V_R = 30V$
Diode capacitance	C_d	4.0	pF	$V_R = 0$, f = 1MHz
Reverse recovery time	t_{rr}	6.0	ns	$I_F = I_R = 10mA$, $i_{R(REC)} = 1.0mA$ (Fig. 1)

SWITCHING TIME TEST DATA

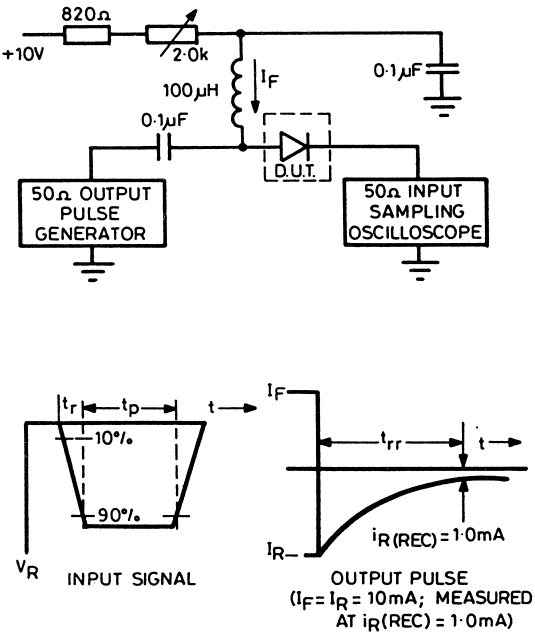
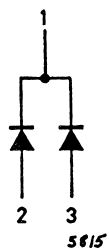


Fig. 1 Recovery time equivalent test circuit

NOTES:
1. A 2.0kΩ variable resistor adjusted for a forward current (V_F) of 10mA.
2. Input pulse is adjusted so $I_{R(peak)}$ is equal to 10mA.
3. $t_p >> t_{rr}$

PIN CONFIGURATION



Devices are identified by a code on the body of the device

FMMD2838 . . . . . A6

High speed switching diode

FMMD6050

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Continuous reverse voltage	V_R	70	V
Peak forward current	I_F	200	mA
Peak forward surge current	I_{FM}	500	mA

CHARACTERISTICS (at 25°C ambient temperature unless otherwise stated).

Parameter	Symbol	Min.	Max.	Unit	Conditions
Static forward voltage	V_F	0.5 0.8	0.7 1.1	V V	I_F=1.0mA I_F=100mA
Static reverse current	I_R	—	0.1	μA	V_R=50V
Total capacitance	C_T	—	2.5	pF	V_R=0
Reverse recovery time	t_{rr}	—	10	ns	I_F=10mA, I_{RM}=10mA I_{rr}=1mA, R_L=100Ω (See Fig. 1, Condition 1)

PARAMETER MEASUREMENT INFORMATION

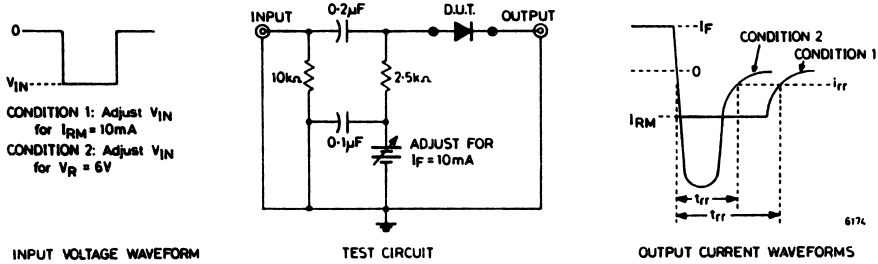


Fig. 1 Reverse recovery time

NOTE 1: The input pulse is supplied by a generator with the following characteristics: $Z_{OUT} = 50\Omega$, $t_r \leqslant 0.5$ns, $t_W = 100$ns.

NOTE 2: Output waveforms are monitored on an oscilloscope with the following characteristics: $t_r \leqslant 0.6$ns, $Z_{IN} = 50\Omega$.

PIN CONFIGURATION

6175

Devices are identified by a code on the body of the device

FMMD6050 . . . . . 5A

High speed switching diode pair common cathode

FMMD6100

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	FMMD6100	Unit
Continuous reverse voltage	V_R	70	V
Peak forward current	I_F	200	mA
Peak forward surge current	I_{FM}	500	mA

CHARACTERISTICS (at $T_j = 25°C$ unless otherwise specified).

Parameter	Symbol	Min.	Max.	Unit	Test conditions
Breakdown voltage	$V_{(BR)}$	70	—	V	$I_R = 10\mu A$
Forward voltage	V_F	0.5 0.8	0.7 1.1	V	$I_F = 1.0mA$ $I_F = 100mA$
Reverse current	I_R	—	0.1	μA	$V_R = 50V$
Diode capacitance	C	—	2.5	pF	$V_R = 0$, f = 1MHz
Reverse recovery time	t_{rr}	—	5	ns	$I_F = I_R = 10mA$, $i_{R(REC)} = 1.0mA$ (Fig. 1)

SWITCHING TIME TEST DATA

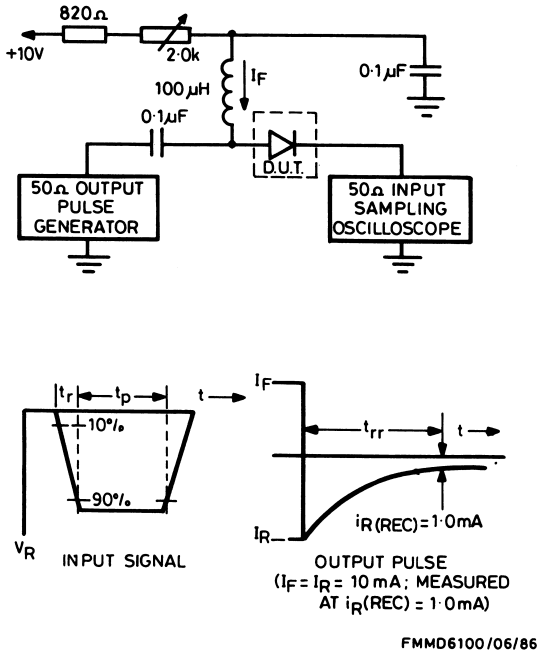
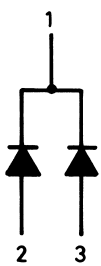


Fig. 1 Recovery time equivalent test circuit

NOTES:
1. A 2.0kΩ variable resistor adjusted for a forward current (V_F) of 10mA.
2. Input pulse is adjusted so $I_{R(peak)}$ is equal to 10mA.
3. $t_p >> t_{rr}$

PIN CONFIGURATION



FMMD6100/06/86

Devices are identified by a code on the body of the device

FMMD6100 . . . . . 5B

High speed switching series diode pair

FMMD7000

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	FMMD7000	Unit
Continuous reverse voltage	V_R	70	V
Peak forward current	I_F	200	mA
Peak forward surge current	I_{FM}	500	mA

CHARACTERISTICS (at $T_j = 25°C$ unless otherwise specified).

Parameter	Symbol	Min.	Max.	Unit	Test conditions
Breakdown voltage	$V_{(BR)}$	100	—	V	$I_R = 100\mu A$
Forward voltage	V_F	0.5 0.8	0.7 1.1	V	$I_F = 1.0mA$ $I_F = 100mA$
Reverse current	I_R	—	0.3	μA	$V_R = 50V$
Diode capacitance	C	—	2.5	pF	$V_R = 0$, f = 1MHz
Reverse recovery time	t_{rr}	—	15	ns	$I_F = I_R = 10mA$, (Fig. 1)

SWITCHING TIME TEST DATA

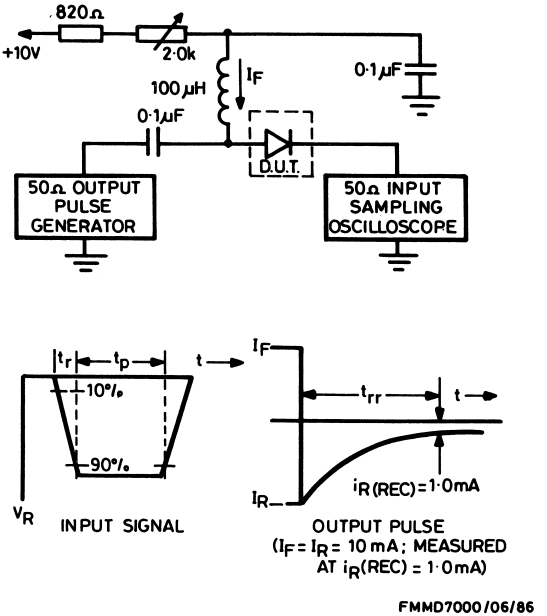
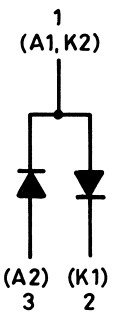


Fig. 1 Recovery time equivalent test circuit

NOTES:

1. A 2.0kΩ variable resistor adjusted for a forward current (V_F) of 10mA.
2. Input pulse is adjusted so $I_{R(peak)}$ is equal to 10mA.
3. $t_p >> t_{rr}$

PIN CONFIGURATION



FMMD7000/06/86

Devices are identified by a code on the body of the device

FMMD7000 . . . . . 5C

NPN silicon planar medium power transistors

FMMT-A05
FMMT-A06

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	FMMT-A05	FMMT-A06	Unit
Collector-Base Voltage	V_{CBO}	60	80	V
Collector-Emitter Voltage	V_{CEO}	60	80	V
Emitter-Base Voltage	V_{EBO}	4.0	4.0	V
Continuous Collector Current	I_C	500	500	mA

CHARACTERISTICS (at 25°C ambient temperature unless otherwise stated).

Parameter	Symbol	FMMT-A05		FMMT-A06		Unit	Conditions
		Min.	Max.	Min.	Max.		
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	60	—	80	—	V	I_C=1 mA*
Emitter-base breakdown voltage	$V_{(BR)EBO}$	4.0	—	4.0	—	V	I_E=100 μA
Collector-emitter cut-off current	I_{CEO}	—	0.1	—	0.1	μA	V_{CE}=60V
Collector-base cut-off current	I_{CBO}	—	0.1	—	0.1	μA μA	V_{CB}=60V V_{CB}=80V
Static forward current transfer ratio	h_{FE}	50 50	— —	50 50	— —		I_C=10 mA V_{CE}=1V* I_C=100 mA V_{CE}=1V*
Collector-emitter saturation voltage	$V_{CE(sat)}$	—	0.25	—	0.25	V	I_C=100 mA I_B=10 mA*
Base-emitter on voltage	$V_{BE(on)}$	—	1.2	—	1.2	V	I_C=100 mA V_{CE}=1V*
Transition frequency	f_T	100	—	100	—	MHz	I_C=10 mA V_{CE}=2V f=100 MHz

*Measured under pulsed conditions. Pulse width=300 μs. Duty cycle=2%.

Devices are identified by a code on the body of the device

FMMT-A05	1H
FMMT-A06	1G
FMMT-A05R	NA
FMMT-A06R	MA-

NPN silicon Darlington transistors

FMMT-A12
FMMT-A13
FMMT-A14

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	FMMT-A12	FMMT-A13,A14	Unit
Collector-Emitter Voltage	V_{CES}	20	30	V
Collector-Emitter Voltage	V_{CEO}	–	30	V
Collector-Base Voltage	V_{CBO}	–	30	V
Emitter-Base Voltage	V_{EBO}	10	10	V
Collector Current (continuous)	I_C	300	300	mA

CHARACTERISTICS (at 25°C ambient temperature).

Parameter	Symbol	Min.	Max.	Units	Conditions
Collector-base breakdown voltage	$V_{(BR)CES}$				
FMMT-A12		20	–	V	$I_C=100\mu A$, $V_{BE}=0$
FMMT-A13, A14		30	–	V	$I_C=100\mu A$, $V_{BE}=0$
Collector cut-off current					
FMMT-A12	I_{CES}	–	100	nA	$V_{CE}=15V$, $V_{BE}=0$
	I_{CBO}	–	100	nA	$V_{CB}=15V$, $I_E=0$
FMMT-A13, A14	I_{CBO}	–	100	nA	$V_{CB}=30V$, $I_E=0$
Emitter cut-off current **(All types)**	I_{EBO}	–	100	nA	$V_{EB}=10V$, $I_C=0$
Static forward current transfer ratio	h_{FE}				
FMMT-A12		20,000	–		$I_C=10mA$, $V_{CE}=5V$
FMMT-A13		5,000	–		$I_C=10mA$, $V_{CE}=5V$
		10,000	–		$I_C=100mA$, $V_{CE}=5V$
FMMT-A14		10,000	–		$I_C=10mA$, $V_{CE}=5V$
		20,000	–		$I_C=100mA$, $V_{CE}=5V$
Collector-emitter saturation voltage	$V_{CE(sat)}$				
FMMT-A12		–	1.0	V	$I_C=10mA$, $I_B=0.01mA$
FMMT-A13, A14		–	1.5	V	$I_C=100mA$, $I_B=0.1mA$
Base-emitter ON voltage	$V_{BE(on)}$				
FMMT-A12		–	1.4	V	$I_C=10mA$, $V_{CE}=5V$
FMMT-A13, A14		–	2.0	V	$I_C=100mA$, $V_{CE}=5V$

Devices are identified by a code on the body of the device

FMMT-A12 . . . . . 3W
FMMT-A13 . . . . . 1M
FMMT-A14 . . . . . 1N

NPN silicon planar small signal transistor

FMMT-A20

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	40	V
Emitter-Base Voltage	V_{EBO}	4	V
Continuous Collector Current	I_C	100	mA

CHARACTERISTICS (at 25°C ambient temperature unless otherwise stated).

Parameter	Symbol	Min.	Max.	Unit	Conditions
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	40	—	V	I_C=1 mA, I_B=0*
Base-emitter breakdown voltage	$V_{(BR)EBO}$	4	—	V	I_E=100μA, I_C=0
Collector base cut-off current	I_{CBO}	—	100	nA	V_{CB}=30V, I_E=0
Static forward current transfer ratio	h_{FE}	40	400		I_C=5mA, V_{CE}=10V*
Collector-emitter saturation voltage	$V_{CE(sat)}$	—	0.25	V	I_C=10mA, I_B=1 mA
Transition frequency	f_T	125	—	MHz	I_C=5mA, V_{CE}=10V* f=100MHz
Output capacitance	C_{obo}	—	4	pF	V_{CB}=10V, I_E=0 f=140kHz

*Measured under pulsed conditions. Pulse width = 300μs, Duty cycle = 2%.

Devices are identified by a code on the body of the device

FMMT-A20 . . . . . 1C
FMMT-A20R 3C

NPN silicon planar high voltage transistors

FMMT-A42
FMMT-A43

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	FMMT-A42	FMMT-A43	Unit
Collector-Base Voltage	V_{CBO}	300	200	V
Collector-Emitter Voltage	V_{CEO}	300	200	V
Emitter-Base Voltage	V_{EBO}	5	5	V
Continuous Collector Current	I_C	200	200	mA

CHARACTERISTICS (at 25°C ambient temperature unless otherwise stated).

Parameter	Symbol	FMMT-A42		FMMT-A43		Unit	Conditions
		Min.	Max.	Min.	Max.		
Collector-base breakdown voltage	$V_{(BR)CBO}$	300	—	200	—	V	$I_C=100\mu A$, $I_E=0$
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	300	—	200	—	V	$I_C=1mA$, $I_B=0$*
Emitter-base breakdown voltage	$V_{(BR)EBO}$	6	—	6	—	V	$I_E=100\mu A$, $I_C=0$
Collector cut-off current	I_{CBO}	— —	0.1 —	— —	— 0.1	μA μA	$V_{CB}=200V$, $I_E=0$ $V_{CB}=160V$, $I_E=0$
Emitter cut-off current	I_{EBO}	— —	0.1 —	— 0.1	—	μA μA	$V_{EB}=6V$, $I_C=0$ $V_{EB}=4V$, $I_C=0$
Collector-emitter saturation voltage	$V_{CE(sat)}$	—	0.5	—	0.4	V	$I_C=20mA$ $I_B=2mA$
Collector-base saturation voltage	$V_{BE(sat)}$	—	0.9	—	0.9	V	$I_C=20mA$ $I_B=2mA$
Static forward current transfer ratio	h_{FE}	25	—	25	—		$I_C=1mA$ $V_{CE}=10V$*
		40	—	40	—		$I_C=10mA$ $V_{CE}=10V$*
		40	—	50	200		$I_C=30mA$ $V_{CE}=10V$*
Transition frequency	f_T	50	—	50	—	MHz	$I_C=10mA$ $V_{CE}=20V$ $f=20MHz$
Output capacitance	C_{obo}	—	6	—	8	pF	$V_{CB}=20V$ $f=1MHz$

*Measured under pulsed conditions. Pulse width = 300μs. Duty cycle = 2%.

Devices are identified by a code on the body of the device

FMMT-A42	3E
FMMT-A42R	7E
FMMT-A43	1E
FMMT-A43R	5E

PNP silicon planar medium power transistors

FMMT-A55
FMMT-A56

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	FMMT-A55	FMMT-A56	Unit
Collector-Base Voltage	V_{CBO}	−60	−80	V
Collector-Emitter Voltage	V_{CEO}	−60	−80	V
Emitter-Base Voltage	V_{EBO}	−4.0	−4.0	V
Continuous Collector Current	I_C	−500	−500	mA

CHARACTERISTICS (at 25°C ambient temperature unless otherwise stated).

Parameter	Symbol	FMMT-A55		FMMT-A56		Unit	Conditions
		Min.	Max.	Min.	Max.		
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	−60	—	−80	—	V	$I_C = -1\,mA$*
Emitter-base breakdown voltage	$V_{(BR)EBO}$	−4.0	—	−4.0	—	V	$I_E = -100\,\mu A$
Collector-emitter cut-off current	I_{CEO}	—	−0.1	—	−0.1	μA	$V_{CE} = -60V$
Collector-base cut-off current	I_{CBO}	—	−0.1	—	−0.1	μA μA	$V_{CB} = -60V$ $V_{CB} = -80V$
Static forward current transfer ratio	h_{FE}	50 50	— —	50 50	— —		$I_C = -10\,mA$, $V_{CE} = -1V$ $I_C = -100\,mA$, $V_{CE} = -1V$
Collector-emitter saturation voltage	$V_{CE(sat)}$	—	−0.25	—	−0.25	V	$I_C = -100\,mA$, $I_B = -10\,mA$*
Base-emitter on voltage	$V_{BE(on)}$	—	−1.2	—	−1.2	V	$I_C = -100\,mA$, $V_{CE} = -1V$*
Transition frequency	f_T	100	—	100	—	MHz	$I_C = -10\,mA$, $V_{CE} = -2V$, f = 100MHz

*Measured under pulsed conditions. Pulse width = 300μs. Duty cycle = 2%.

Devices are identified by a code on the body of the device

FMMT-A55	2H
FMMT-A56	2G
FMMT-A55R	NB
FMMT-A56R	MB

PNP silicon Darlington transistors

FMMT A63
FMMT A64

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	FMMT A63	FMMT A64	Unit
Collector-Base Voltage	V_{CBO}	−30	−30	V
Collector-Emitter Voltage	V_{CEO}	−30	−30	V
Emitter-Base Voltage	V_{EBO}	−10	−10	V
Continuous Collector Current	I_C	−500	−500	mA
Peak Collector Current	I_{CM}	−800	−800	mA
Base Current	I_B	−100	−100	mA
Peak Base Current	I_{BM}	−200	−200	mA

ELECTRICAL CHARACTERISTICS (at $T_{amb} = 25°C$ unless otherwise stated).

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
Collector-base breakdown voltage	$V_{(BR)CBO}$	−30	—	—	V	$I_C = -10\mu A$, $I_E = 0$
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	−30	—	—	V	$I_C = -10\mu A$, $I_B = 0$
Emitter-base breakdown voltage	$V_{(BR)EBO}$	−10	—	—	V	$I_E = -10\mu A$, $I_C = 0$
Collector cut-off current	I_{CBO}	—	—	−100	nA	$V_{CB} = -30V$, $I_E = 0$
Emitter cut-off current	I_{EBO}	—	—	−100	nA	$V_{EB} = -10V$, $I_C = 0$
Static forward current transfer ratio FMMT A63	h_{FE}*	5K	—	—		$I_C = -10mA$, $V_{CE} = -5V$
FMMT A64		10K	—	—		
FMMT A63		10K	—	—		$I_C = -100mA$, $V_{CE} = -5V$
FMMT A64		20K	—	—		
Collector-emitter saturation voltage	$V_{CE(sat)}$*	—	—	−1.5	V	$I_C = -100mA$, $I_B = -0.1mA$
Base-emitter saturation voltage	$V_{BE(sat)}$*	—	—	−2.0	V	$I_C = -100mA$, $I_B = -0.1mA$
Transition frequency	f_T	125	—	—	MHz	$I_C = -50mA$, $V_{CE} = -5V$ f = 20MHz

*Measured under pulsed conditions. Pulse width = 300μs. Duty cycle ⩽2%.

Devices are identified by a code on the body of the device

FMMT A63 . . . . . Z2U
FMMT A64 . . . . . Z2V

PNP silicon planar small signal transistor

FMMT-A70

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	−40	V
Emitter-Base Voltage	V_{EBO}	−4	V
Continuous Collector Current	I_C	−100	mA

CHARACTERISTICS (at 25°C ambient temperature unless otherwise stated).

Parameter	Symbol	Min.	Max.	Unit	Conditions
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	−40	—	V	$I_C = -1\,mA$, $I_B = 0$*
Base-emitter breakdown voltage	$V_{(BR)EBO}$	−4	—	V	$I_E = -100\,\mu A$, $I_C = 0$
Collector base cut-off current	I_{CBO}	—	−100	nA	$V_{CB} = -30V$, $I_E = 0$
Static forward current transfer ratio	h_{FE}	40	400		$I_C = -5\,mA$, $V_{CE} = -10V$*
Collector-emitter saturation voltage	$V_{CE(sat)}$	—	−0.25	V	$I_C = -10\,mA$, $I_B = -1\,mA$*
Transition frequency	f_T	125	—	V	$I_C = -5\,mA$, $V_{CE} = 10V$* $f = 100\,MHz$
Output capacitance	C_{obo}	—	4	pF	$V_{CB} = -10V$, $I_E = 0$ $f = 100\,kHz$

*Measured under pulsed conditions. Pulse duration = 300μs, Duty cycle = 2%.

Devices are identified by a code on the body of the device

FMMT-A70 . . . . . 2C

PNP silicon planar high voltage transistors

FMMT-A92
FMMT-A93

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	FMMT-A92	FMMT-A93	Unit
Collector-Base Voltage	V_{CBO}	−300	−200	V
Collector-Emitter Voltage	V_{CEO}	−300	−200	V
Emitter-Base Voltage	V_{EBO}	−5	−5	V
Continuous Collector Current	I_C	−200	−200	mA

CHARACTERISTICS (at 25°C ambient temperature unless otherwise stated).

Parameter	Symbol	FMMT-A92		FMMT-A93		Unit	Conditions
		Min.	Max.	Min.	Max.		
Collector-base breakdown voltage	$V_{(BR)CBO}$	−300	—	−200	—	V	$I_C = -100\mu A$, $I_E = 0$
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	−300	—	−200	—	V	$I_C = -1\,mA$, $I_B = 0$*
Emitter-base breakdown voltage	$V_{(BR)EBO}$	−5	—	−5	—	V	$I_E = -100\mu A$, $I_C = 0$
Collector cut-off current	I_{CBO}	— —	−0.25 —	— —	— −0.25	μA μA	$V_{CB} = -200V$, $I_E = 0$ $V_{CB} = -160V$, $I_E = 0$
Emitter cut-off current	I_{EBO}	—	−0.1	—	−0.1	μA	$V_{EB} = -3V$, $I_C = 0$
Collector-emitter saturation voltage	$V_{CE(sat)}$	—	−0.5	—	−0.4	V	$I_C = -20\,mA$ $I_B = -2\,mA$
Collector-base saturation voltage	$V_{BE(sat)}$	—	−0.9	—	−0.9	V	$I_C = -20\,mA$ $I_B = -2\,mA$
Static forward current transfer ratio	h_{FE}	25	—	25	—		$I_C = -1\,mA$ $V_{CE} = -10V$*
		40	—	40	—		$I_C = -10\,mA$ $V_{CE} = -10V$*
		25	—	30	150		$I_C = -30\,mA$ $V_{CE} = -10V$*
Transition frequency	f_T	50	—	50	—	MHz	$I_C = -10\,mA$ $V_{CE} = -20V$ $f = 20\,MHz$
Output capacitance	C_{obo}	—	6	—	8	pF	$V_{CB} = -20V$ $f = 1\,MHz$

*Measured under pulsed conditions. Pulse width = 200μs. Duty cycle = 2%.

Devices are identified by a code on the body of the device

FMMT-A92	4E
FMMT-A92R	8E
FMMT-A93	2E
FMMT-A93R	6E

NPN silicon darlington transistors

FMMT38A
FMMT38B
FMMT38C

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Collector-Base Voltage	V_{CBO}	80	V
Collector-Emitter Voltage	V_{CEO}	60	V
Emitter-Base Voltage	V_{EBO}	10	V
Continuous Collector Current	I_C	300	mA
Peak Collector Current	I_{CM}	800	mA

CHARACTERISTICS (at 25°C ambient temperature).

Parameter	Symbol	Min.	Max.	Unit	Conditions
Collector-base breakdown voltage	$V_{(BR)CBO}$	80	—	V	$I_C=10\mu A$, $I_E=0$
Collector-emitter breakdown voltage	$V_{CEO(sus)}$	60	—	V	$I_C=10mA$, $I_B=0$
Emitter-base breakdown voltage	$V_{(BR)EBO}$	10	—	V	$I_E=10\mu A$, $I_C=0$
Collector base cut-off current	I_{CBO}	—	100	nA	$V_{CB}=60V$, $I_E=0$
Emitter-base cut-off current	I_{EBO}	—	100	nA	$V_{EB}=8V$, $I_C=0$
Static forward current transfer ratio	h_{FE}				
	FMMT38A	500	—		$I_C=100mA$, $I_C=500mA$ } $V_{CE}=5V$*
		1000	—		
	FMMT38B	2000	—		$I_C=100mA$, $I_C=500mA$ } $V_{CE}=5V$*
		4000	—		
	FMMT38C	5000	—		$I_C=100mA$, $I_C=500mA$ } $V_{CE}=5V$*
		10000	—		
Collector-emitter saturation voltage	$V_{CE(sat)}$	—	1.25	V	$I_C=800mA$, $I_B=8mA$*
Base-emitter on voltage	$V_{BE(on)}$	—	1.8	V	$I_C=800mA$, $V_{CE}=5V$*

*Measured under pulsed conditions. Pulse width = 300μs, Duty cycle = ≤2%.

Devices are identified by a code on the body of the device

FMMT38A	4J
FMMT38B	5J
FMMT38C	7J

Silicon NPN avalanche transistor

FMMT415

The FMMT415 has been specifically developed to operate in the avalanche mode. It is designed for driving pulsed laser diodes. Also it is ideally suited in other applications for the generation of very fast edges.

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	FMMT415	Unit
Collector-Base Voltage	V_{CBO}	260	V
Collector-Emitter Voltage	V_{CEO}	100	V
Emitter-Base Voltage	V_{EBO}	6	V
Continuous Collector Current	I_C	0.5	A
Peak Collector Current (Max. pulse width 20nsecs)	I_{CM}	60	A

CHARACTERISTICS (at $T_{amb}=25°C$ unless otherwise stated)

Parameter	Symbol	Min.	Max.	Unit	Conditions
Collector-emitter breakdown voltage	$V_{(BR)CES}$	260	—	V	$I_C=1mA$ $T_{amb}=-55$ to $+175°C$
Emitter-base breakdown voltage	$V_{(BR)EBO}$	6	—	V	$I_E=10\mu A$
Collector-base cut-off current	I_{CBO}	— —	0.1 10	μA μA	$V_{CB}=180V$ $V_{CB}=180V$, $T=100°C$
Emitter-base cut-off current	I_{EBO}	—	0.1	μA	$V_{EB}=4V$
Static forward current transfer ratio	h_{FE}	25	—	—	$I_C=10mA$, $V_{CE}10V$*
Collector-emitter saturation voltage	$V_{CE(sat)}$	—	0.5	V	$I_C=10mA$, $I_B=1mA$*
Base-emitter saturation voltage	$V_{BE(sat)}$	—	0.9	V	$I_C=10mA$, $I_B=1mA$*
Current in second breakdown (pulsed)	I_{SB}	15 25	— —	A A	$V_C=200V$ $V_C=250V$
Collector-base capacitance	C_{cb}	—	8	pF	$V_{CB}=20V$, $I_E=0$ $f=100MHz$
Transition frequency	f_T	40	—	MHz	$V_{CE}=20V$, $I_C=10\mu A$ $f=20MHz$

*Measured under pulsed conditions: Pulse width $=300\mu s$, Duty cycle $\leqslant 2\%$.

Devices are identified by a code on the body of the device

FMMT415 415

NPN silicon medium power transistors

FMMT 449

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	FMMT 449	Unit
Collector-Base Voltage	V_{CBO}	50	V
Collector-Emitter Voltage	V_{CEO}	30	V
Emitter-Base Voltage	V_{EBO}	5	V
Peak Collector Current**	I_{CM}	2	A
Continuous Collector Current	I_C	1	A
Base Current	I_B	200	mA

ELECTRICAL CHARACTERISTICS (at $T_{amb} = 25°C$ unless otherwise stated)

Parameter	Symbol	Min.	Max.	Unit	Test Conditions
Collector-base breakdown voltage	$V_{(BR)CBO}$	50	—	V	$I_C = 100\mu A$
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	30	—	V	$I_C = 10mA$
Emitter-base breakdown voltage	$V_{(BR)EBO}$	5	—	V	$I_E = 100\mu A$
Collector-base cut-off current	I_{CBO}	— —	0.1 10	μA μA	$V_{CB} = 40V$ $V_{CB} = 40V$, $T_A = 100°C$
Emitter-base cut-off current	I_{EBO}	—	0.1	μA	$V_{EB} = 4V$
Collector-emitter saturation voltage	$V_{CE(sat)}$*	— —	0.5 1.0	V V	$I_C = 1A$, $I_B = 0.1A$ $I_C = 2A$, $I_B = 0.2A$
Base-emitter saturation voltage	$V_{BE(sat)}$*	—	1.25	V	$I_C = 1A$, $I_B = 0.1A$
Base-emitter turn-on voltage	$V_{BE(on)}$*	—	1.0	V	$I_C = 1A$, $V_{CE} = 2V$
Static forward current transfer ratio	h_{FE}*	70 100 80 40	— 300 — —		$I_C = 50mA$, $V_{CE} = 2V$ $I_C = 500mA$, $V_{CE} = 2V$ $I_C = 1A$, $V_{CE} = 2V$ $I_C = 2A$, $V_{CE} = 2V$
Transition frequency	f_T	150	—	MHz	$I_C = 50mA$, $V_{CE} = 10V$ $f = 100MHz$
Output capacitance	C_{obo}	—	15	pF	$V_{CB} = 10V$, $f = 1MHz$

*Measured under pulsed conditions. Pulse width = 300μs. Duty cycle $\leq 2\%$.

Devices are identified by a code on the body of the device

FMMT 449 449

NPN silicon medium power transistor

FMMT 451

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	FMMT 451	Unit
Collector-Base Voltage	V_{CBO}	80	V
Collector-Emitter Voltage	V_{CEO}	60	V
Emitter-Base Voltage	V_{EBO}	5	V
Peak Pulse Current**	I_{CM}	2	A
Continuous Collector Current	I_C	1	A
Base Current	I_B	200	mA

ELECTRICAL CHARACTERISTICS (at $T_{amb} = 25°C$ unless otherwise stated)

Parameter	Symbol	Min.	Max.	Unit	Test Conditions
Collector-emitter sustaining voltage	$V_{CEO(sus)}$	60	—	V	$I_C = 10mA$*
Collector-base cut-off current	I_{CBO}	—	0.1	μA	$V_{CB} = 60V$
Emitter-base cut-off current	I_{EBO}	—	0.1	μA	$V_{EB} = 4V$
Collector-emitter saturation voltage	$V_{CE(sat)}$	—	0.35	V	$I_C = 150mA$* $I_B = 15mA$
Base-emitter saturation voltage	$V_{BE(sat)}$	—	1.1	V	$I_C = 150mA$* $I_B = 15mA$
Static forward current transfer ratio	h_{FE}	50 10	150 —		$I_C = 150mA$* $V_{CE} = 10V$ $I_C = 1A$* $V_{CE} = 10V$
Transition frequency	f_T	150	—	MHz	$I_C = 50mA$ $V_{CE} = 10V$ $f = 100MHz$
Output capacitance	C_{obo}	—	15	pF	$V_{CB} = 10V$ $f = 1MHz$

*Measured under pulsed conditions. Pulse width = 300μs. Duty cycle ⩽2%.

Devices are identified by a code on the body of the device

FMMT 451 451

NPN silicon planar medium power transistor

FMMT 455

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	FMMT 455	Unit
Collector-Base Voltage	V_{CBO}	160	V
Collector-Emitter Voltage	V_{CEO}	140	V
Emitter-Base Voltage	V_{EBO}	5	V
Peak Pulse Current	I_{CM}	2	A
Continuous Direct Current	I_C	1	A
Base Current	I_B	200	mA

ELECTRICAL CHARACTERISTICS (at $T_j = 25°C$ unless otherwise stated)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
Collector-base cut-off current	I_{CBO}	—	—	0.1	μA	$V_{CB} = 140V$
Emitter-base cut-off current	I_{EBO}	—	—	0.1	μA	$V_{EB} = 4V$
Collector-emitter saturation voltage	$V_{CE(sat)}$	—	—	0.7	V	$I_C = 150mA$ $I_B = 15mA$
Collector-emitter sustaining voltage	$V_{CEO(sus)}$	140	—	—	V	$I_C = 10mA$
Static forward current transfer ratio	h_{FE}	100 —	— 10	300 —		$I_C = 150mA$, $V_{CE} = 10V$* $I_C = 1A$, $V_{CE} = 10V$*
Transition frequency	f_T	100	—	—	MHz	$I_C = 50mA$, $V_{CE} = 10V$ $f = 100MHz$
Output capacitance	C_{obo}	—	—	15	pF	$V_{CB} = 10V$ $f = 1MHz$

*Measured under pulsed conditions. Pulse width = 300μs. Duty cycle ⩽2%.

Devices are identified by a code on the body of the device

FMMT455 455

NPN silicon medium power transistor

FMMT 489

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	FMMT 489	Unit
Collector-Base Voltage	V_{CBO}	50	V
Collector-Emitter Voltage	V_{CEO}	30	V
Emitter-Base Voltage	V_{EBO}	5	V
Peak Pulse Current**	I_{CM}	4	A
Continuous Collector Current	I_C	1	A
Base Current	I_B	200	mA

ELECTRICAL CHARACTERISTICS (at $T_{amb} = 25°C$ unless otherwise stated)

Parameter	Symbol	Min.	Max.	Unit	Test Conditions
Collector-base breakdown voltage	$V_{(BR)CBO}$	50	—	V	$I_C = 100\mu A$
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	30	—	V	$I_C = 10mA$*
Emitter-base breakdown voltage	$V_{(BR)EBO}$	5	—	V	$I_E = 100\mu A$
Collector cut-off current	I_{CBO}	—	100	nA	$V_{CB} = 30V$
Emitter cut-off current	I_{EBO}	—	100	nA	$V_{EB} = 4V$
Collector-emitter cut-off current	I_{CES}	—	100	nA	$V_{CES} = 30V$
Collector-emitter saturation voltage	$V_{CE(sat)}$	— —	0.3 0.6	V V	$I_C = 1A$, $I_B = 0.1A$* $I_C = 2A$, $I_B = 0.2A$*
Base-emitter saturation voltage	$V_{BE(sat)}$	—	1.1	V	$I_C = 1A$, $I_B = 0.1A$*
Base-emitter turn-on voltage	$V_{BE(on)}$	—	1.0	V	$I_C = 1A$, $V_{CE} = 2V$*
Static forward current transfer ratio	h_{FE}	100 100 60 20	— 300 — —		$I_C = 1mA$, $V_{CE} = 2V$ $I_C = 1A$, $V_{CE} = 2V$* $I_C = 2A$, $V_{CE} = 2V$* $I_C = 4A$, $V_{CE} = 2V$*
Transition frequency	f_T	150	—	MHz	$I_C = 50mA$, $V_{CE} = 10V$ $f = 100MHz$
Output capacitance	C_{obo}	—	10	pF	$V_{CB} = 10V$, $f = 1MHz$

*Measured under pulsed conditions. Pulse width = 300μs. Duty cycle ≤ 2%.

Devices are identified by a code on the body of the device

FMMT 489 489

NPN silicon medium power transistor

FMMT 491

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	FMMT 491	Unit
Collector-Base Voltage	V_{CBO}	80	V
Collector-Emitter Voltage	V_{CEO}	60	V
Emitter-Base Voltage	V_{EBO}	5	V
Peak Pulse Current**	I_{CM}	2	A
Continuous Collector Current	I_C	1	A
Base Current	I_B	200	mA

ELECTRICAL CHARACTERISTICS (at $T_{amb} = 25°C$ unless otherwise stated)

Parameter	Symbol	Min.	Max.	Unit	Test Conditions
Collector-base breakdown voltage	$V_{(BR)CBO}$	80	—	V	$I_C = 100\mu A$
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	60	—	V	$I_C = 10mA$*
Emitter-base breakdown voltage	$V_{(BR)EBO}$	5	—	V	$I_E = 100\mu A$
Collector cut-off current	I_{CBO}	—	100	nA	$V_{CB} = 60V$
Emitter cut-off current	I_{EBO}	—	100	nA	$V_{EB} = 4V$
Collector-emitter cut-off current	I_{CES}	—	100	nA	$V_{CES} = 60V$
Collector-emitter saturation voltage	$V_{CE(sat)}$	— —	0.25 0.5	V V	$I_C = 500mA$, $I_B = 50mA$* $I_C = 1A$, $I_B = 0.1A$*
Base-emitter saturation voltage	$V_{BE(sat)}$	—	1.1	V	$I_C = 1A$, $I_B = 0.1A$*
Base-emitter turn-on voltage	$V_{BE(on)}$	—	1.0	V	$I_C = 1A$, $V_{CE} = 5V$*
Static forward current transfer ratio	h_{FE}	100 100 80 30	— 300 — —		$I_C = 1mA$ $I_C = 500mA$* $I_C = 1A$* $I_C = 2A$* } $V_{CE} = 5V$
Transition frequency	f_T	150	—	MHz	$I_C = 50mA$, $V_{CE} = 10V$ $f = 100MHz$
Output capacitance	C_{obo}	—	10	pF	$V_{CB} = 10V$, $f = 1MHz$

*Measured under pulsed conditions. Pulse width = 300μs. Duty cycle ≤2%.

Devices are identified by a code on the body of the device

FMMT 491 491

NPN silicon medium power transistor

FMMT 491A

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	FMMT 491A	Unit
Collector-Base Voltage	V_{CBO}	40	V
Collector-Emitter Voltage	V_{CEO}	40	V
Emitter-Base Voltage	V_{EBO}	5	V
Peak Pulse Current**	I_{CM}	2	A
Continuous Collector Current	I_C	1	A
Base Current	I_B	200	mA

ELECTRICAL CHARACTERISTICS (at $T_{amb} = 25°C$ unless otherwise stated)

Parameter	Symbol	Min.	Max.	Unit	Test Conditions
Collector-base breakdown voltage	$V_{(BR)CBO}$	40	—	V	$I_C = 100\mu A$
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	40	—	V	$I_C = 10mA$*
Emitter-base breakdown voltage	$V_{(BR)EBO}$	5	—	V	$I_E = 100\mu A$
Collector cut-off current	I_{CBO}	—	100	nA	$V_{CB} = 30V$
Emitter cut-off current	I_{EBO}	—	100	nA	$V_{EB} = 4V$
Collector-emitter cut-off current	I_{CES}	—	100	nA	$V_{CES} = 30V$
Collector-emitter saturation voltage	$V_{CE(sat)}$	— —	0.3 0.5	V V	$I_C = 500mA$, $I_B = 50mA$* $I_C = 1A$, $I_B = 0.1A$*
Base-emitter saturation voltage	$V_{BE(sat)}$	—	1.1	V	$I_C = 1A$, $I_B = 0.1A$*
Base-emitter turn-on voltage	$V_{BE(on)}$	—	1.0	V	$I_C = 1A$, $V_{CE} = 5V$*
Static forward current transfer ratio	h_{FE}	300 300 200 35	— 900 — —		$I_C = 1mA$ $I_C = 500mA$* $I_C = 1A$* $I_C = 2A$* } $V_{CE} = 5V$
Transition frequency	f_T	150	—	MHz	$I_C = 50mA$, $V_{CE} = 10V$ $f = 100MHz$
Output capacitance	C_{obo}	—	10	pF	$V_{CB} = 10V$, $f = 1MHz$

*Measured under pulsed conditions. Pulse width = 300μs. Duty cycle ≤ 2%.

Devices are identified by a code on the body of the device

FMMT 491A 41A

NPN silicon medium power transistor

FMMT 493

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	FMMT 493	Unit
Collector-Base Voltage	V_{CBO}	120	V
Collector-Emitter Voltage	V_{CEO}	100	V
Emitter-Base Voltage	V_{EBO}	5	V
Peak Pulse Current**	I_{CM}	2	A
Continuous Collector Current	I_C	1	A
Base Current	I_B	200	mA

ELECTRICAL CHARACTERISTICS (at $T_{amb} = 25°C$ unless otherwise stated)

Parameter	Symbol	Min.	Max.	Unit	Test Conditions
Collector-base breakdown voltage	$V_{(BR)CBO}$	120	—	V	$I_C = 100\mu A$
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	100	—	V	$I_C = 10mA$*
Emitter-base breakdown voltage	$V_{(BR)EBO}$	5	—	V	$I_E = 100\mu A$
Collector cut-off current	I_{CBO}	—	100	nA	$V_{CB} = 100V$
Emitter cut-off current	I_{EBO}	—	100	nA	$V_{EB} = 4V$
Collector-emitter cut-off current	I_{CES}	—	100	nA	$V_{CES} = 100V$
Collector-emitter saturation voltage	$V_{CE(sat)}$	— —	0.3 0.6	V V	$I_C = 500mA$, $I_B = 50mA$* $I_C = 1A$, $I_B = 0.1A$*
Base-emitter saturation voltage	$V_{BE(sat)}$	—	1.15	V	$I_C = 1A$, $I_B = 0.1A$*
Base-emitter turn-on voltage	$V_{BE(on)}$	—	1.0	V	$I_C = 1A$, $V_{CE} = 10V$*
Static forward current transfer ratio	h_{FE}	100 100 60 20	— 300 — —		$I_C = 1mA$ $I_C = 250mA$* $I_C = 500mA$* $I_C = 1A$* } $V_{CE} = 10V$
Transition frequency	f_T	150	—	MHz	$I_C = 50mA$, $V_{CE} = 10V$ $f = 100MHz$
Output capacitance	C_{obo}	—	10	pF	$V_{CB} = 10V$, $f = 1MHz$

*Measured under pulsed conditions. Pulse width = 300μs. Duty cycle $\leq 2\%$.

Devices are identified by a code on the body of the device

FMMT 493 493

NPN silicon medium power transistor

FMMT 494

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	FMMT 494	Unit
Collector-Base Voltage	V_{CBO}	140	V
Collector-Emitter Voltage	V_{CEO}	120	V
Emitter-Base Voltage	V_{EBO}	5	V
Peak Pulse Current**	I_{CM}	2	A
Continuous Collector Current	I_C	1	A
Base Current	I_B	200	mA

ELECTRICAL CHARACTERISTICS (at $T_{amb} = 25°C$ unless otherwise stated)

Parameter	Symbol	Min.	Max.	Unit	Test Conditions
Collector-base breakdown voltage	$V_{(BR)CBO}$	140	—	V	$I_C = 100\mu A$
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	120	—	V	$I_C = 10mA$*
Emitter-base breakdown voltage	$V_{(BR)EBO}$	5	—	V	$I_E = 100\mu A$
Collector cut-off current	I_{CBO}	—	100	nA	$V_{CB} = 120V$
Emitter cut-off current	I_{EBO}	—	100	nA	$V_{EB} = 4V$
Collector-emitter cut-off current	I_{CES}	—	100	nA	$V_{CES} = 120V$
Collector-emitter saturation voltage	$V_{CE(sat)}$	— —	0.2 0.3	V V	$I_C = 250mA$, $I_B = 25mA$* $I_C = 500mA$, $I_B = 50mA$*
Base-emitter saturation voltage	$V_{BE(sat)}$	—	1.1	V	$I_C = 500mA$, $I_B = 50mA$*
Base-emitter turn-on voltage	$V_{BE(on)}$	—	1.0	V	$I_C = 500mA$, $V_{CE} = 10V$*
Static forward current transfer ratio	h_{FE}	100 100 60 20	— 300 — —		$I_C = 1mA$ $I_C = 250mA$* $I_C = 500mA$* $I_C = 1A$* } $V_{CE} = 10V$
Transition frequency	f_T	100	—	MHz	$I_C = 50mA$, $V_{CE} = 10V$ $f = 100MHz$
Output capacitance	C_{obo}	—	10	pF	$V_{CB} = 10V$, $f = 1MHz$

*Measured under pulsed conditions. Pulse width = 300μs. Duty cycle ⩽2%.

Devices are identified by a code on the body of the device

FMMT 494 494

NPN silicon medium power transistor

FMMT 495

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	FMMT 495	Unit
Collector-Base Voltage	V_{CBO}	170	V
Collector-Emitter Voltage	V_{CEO}	150	V
Emitter-Base Voltage	V_{EBO}	5	V
Peak Pulse Current**	I_{CM}	2	A
Continuous Collector Current	I_C	1	A
Base Current	I_B	200	mA

ELECTRICAL CHARACTERISTICS (at $T_{amb} = 25°C$ unless otherwise stated)

Parameter	Symbol	Min.	Max.	Unit	Test Conditions
Collector-base breakdown voltage	$V_{(BR)CBO}$	170	—	V	$I_C = 100\mu A$
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	150	—	V	$I_C = 10mA$*
Emitter-base breakdown voltage	$V_{(BR)EBO}$	5	—	V	$I_E = 100\mu A$
Collector cut-off current	I_{CBO}	—	100	nA	$V_{CB} = 150V$
Emitter cut-off current	I_{EBO}	—	100	nA	$V_{EB} = 4V$
Collector-emitter cut-off current	I_{CES}	—	100	nA	$V_{CES} = 150V$
Collector-emitter saturation voltage	$V_{CE(sat)}$	— —	0.2 0.3	V V	$I_C = 250mA$, $I_B = 25mA$* $I_C = 500mA$, $I_B = 50mA$*
Base-emitter saturation voltage	$V_{BE(sat)}$	—	1.0	V	$I_C = 500mA$, $I_B = 50mA$*
Base-emitter turn-on voltage	$V_{BE(on)}$	—	1.0	V	$I_C = 500mA$, $V_{CE} = 10V$*
Static forward current transfer ratio	h_{FE}	100 100 50 10	— 300 — —		$I_C = 1mA$ $I_C = 250mA$* $I_C = 500mA$* $I_C = 1A$* } $V_{CE} = 10V$
Transition frequency	f_T	100	—	MHz	$I_C = 50mA$, $V_{CE} = 10V$ $f = 100MHz$
Output capacitance	C_{obo}	—	10	pF	$V_{CB} = 10V$, $f = 1MHz$

*Measured under pulsed conditions. Pulse width = 300μs. Duty cycle $\leq 2\%$.

Devices are identified by a code on the body of the device

FMMT 495 495

NPN silicon medium power transistor

FMMT 497

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	FMMT 497	Unit
Collector-Base Voltage	V_{CBO}	300	V
Collector-Emitter Voltage	V_{CEO}	300	V
Emitter-Base Voltage	V_{EBO}	5	V
Peak Pulse Current**	I_{CM}	1	A
Continuous Collector Current	I_C	0.5	A
Base Current	I_B	200	mA

ELECTRICAL CHARACTERISTICS (at $T_{amb} = 25°C$ unless otherwise stated)

Parameter	Symbol	Min.	Max.	Unit	Test Conditions
Collector-base breakdown voltage	$V_{(BR)CBO}$	300	—	V	$I_C = 100\mu A$
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	300	—	V	$I_C = 10mA$*
Emitter-base breakdown voltage	$V_{(BR)EBO}$	5	—	V	$I_E = 100\mu A$
Collector cut-off current	I_{CBO}	—	100	nA	$V_{CB} = 250V$
Emitter cut-off current	I_{EBO}	—	100	nA	$V_{EB} = 4V$
Collector-emitter cut-off current	I_{CES}	—	100	nA	$V_{CES} = 250V$
Collector-emitter saturation voltage	$V_{CE(sat)}$	— —	0.2 0.3	V V	$I_C = 100mA$, $I_B = 10mA$ $I_C = 250mA$, $I_B = 25mA$*
Base-emitter saturation voltage	$V_{BE(sat)}$	—	1.0	V	$I_C = 250mA$, $I_B = 25mA$*
Base-emitter turn-on voltage	$V_{BE(on)}$	—	1.0	V	$I_C = 250mA$, $V_{CE} = 10V$*
Static forward current transfer ratio	h_{FE}	100 100 20	— 300 —		$I_C = 1mA$ $I_C = 100mA$* $I_C = 250mA$* } $V_{CE} = 10V$
Transition frequency	f_T	75	—	MHz	$I_C = 50mA$, $V_{CE} = 10V$ $f = 100MHz$
Output capacitance	C_{obo}	—	5	pF	$V_{CB} = 10V$, $f = 1MHz$

*Measured under pulsed conditions. Pulse width = 300μs. Duty cycle ≤ 2%.

Devices are identified by a code on the body of the device

FMMT 497 497

PNP silicon medium power transistors

FMMT 549
FMMT 549A

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	FMMT 549/A	Unit
Collector-Base Voltage	V_{CBO}	−35	V
Collector-Emitter Voltage	V_{CEO}	−30	V
Emitter-Base Voltage	V_{EBO}	−5	V
Peak Collector Current**	I_{CM}	−2	A
Continuous Collector Current	I_C	−1	A

ELECTRICAL CHARACTERISTICS (at $T_{amb} = 25°C$ unless otherwise stated)

Parameter	Symbol	Min.	Max.	Unit	Test Conditions
Collector-base breakdown voltage	$V_{(BR)CBO}$	−35	—	V	$I_C = -100\mu A$
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	−30	—	V	$I_C = -10mA$,
Emitter-base breakdown voltage	$V_{(BR)EBO}$	−5	—	V	$I_E = -100\mu A$,
Collector cut-off current	I_{CBO}	— —	−0.1 −10	μA μA	$V_{CB} = -30V$ $V_{CB} = -30V$, $T_A = 100°C$
Emitter cut-off current	I_{EBO}	—	−0.1	μA	$V_{EB} = -4V$
Collector-emitter saturation voltage FMMT 549A	$V_{CE(sat)}$	— — —	−0.5 −0.75 −0.3	V V V	$I_C = -1A$, $I_B = -100mA$* $I_C = -2A$, $I_B = -200mA$* $I_C = -100mA$, $I_B = -1mA$
Base-emitter saturation voltage	$V_{BE(sat)}$	—	−1.25	V	$I_C = -1A$, $I_B = -100mA$*
Base-emitter turn-on voltage	$V_{BE(on)}$	—	−1.0	V	$I_C = -1A$, $V_{CE} = -2V$*
Static forward current transfer ratio FMMT 549 FMMT 549A	h_{FE}	70 100 150 80 40	— 300 500 — —		$I_C = -50mA$, $V_{CE} - 2V$ $I_C = -500mA$*, $V_{CE} = -2V$ $I_C = -1A$, $V_{CE} = -2V$* $I_C = -2A$, $V_{CE} = -2V$*
Transition frequency	f_T	100	—	MHz	$I_C = -100mA$, $V_{CE} = -5V$ $f = 100MHz$
Output capacitance	C_{obo}	—	25	pF	$V_{CB} = -10V$, $f = 1MHz$

*Measured under pulsed conditions. Pulse width = 300μs. Duty cycle ≤ 2%.

ELECTRICAL CHARACTERISTICS (continued)

Parameter	Symbol	Min.	Max.	Unit	Test Conditions
Switching times	T_{on}		300 typ	ns	$I_C = -500mA$
	T_{off}		50 typ	ns	$I_{B1} = I_{B2} = -50mA$ $V_{CC} = -10V$

Devices are identified by a code on the body of the device

FMMT 549 549

FMMT 549A 59A

PNP silicon medium power transistor

FMMT 551

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	FMMT 551	Unit
Collector-Base Voltage	V_{CBO}	−80	V
Collector-Emitter Voltage	V_{CEO}	−60	V
Emitter-Base Voltage	V_{EBO}	−5	V
Peak Pulse Current**	I_{CM}	−2	A
Continuous Collector Current	I_C	−1	A
Base Current	I_B	−200	mA

ELECTRICAL CHARACTERISTICS (at T_{amb} = 25°C unless otherwise stated)

Parameter	Symbol	Min.	Max.	Unit	Test Conditions
Collector-emitter sustaining voltage	$V_{CEO(sus)}$	−60	—	V	I_C = −10mA*
Collector-base cut-off current	I_{CBO}	—	−0.1	μA	V_{CB} = −60V
Emitter-base cut-off current	I_{EBO}	—	−0.1	μA	V_{EB} = −4V
Collector-emitter saturation voltage	$V_{CE(sat)}$	—	−0.35	V	I_C = −150mA* I_B = −15mA
Base-emitter saturation voltage	$V_{BE(sat)}$	—	−1.1	V	I_C = 150mA* I_B = −15mA
Static forward current transfer ratio	h_{FE}	50 10	150 —		I_C = −150mA* V_{CE} = −10V I_C = −1A* V_{CE} = −10V
Transition frequency	f_T	150	—	MHz	I_C = −50mA V_{CE} = −10V f = 100MHz
Output capacitance	C_{obo}	—	25	pF	V_{CB} = −10V f = 1MHz

*Measured under pulsed conditions. Pulse width = 300μs. Duty cycle ⩽2%.

Devices are identified by a code on the body of the device

FMMT 551 551

PNP silicon medium power transistors

FMMT 555

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	FMMT 555	Unit
Collector-Base Voltage	V_{CBO}	−160	V
Collector-Emitter Voltage	V_{CEO}	−150	V
Emitter-Base Voltage	V_{EBO}	−5	V
Peak Pulse Current**	I_{CM}	−2	A
Continuous Collector Current	I_C	−1	A
Base Current	I_B	−200	mA

ELECTRICAL CHARACTERISTICS (at T_{amb} = 25°C unless otherwise stated)

Parameter	Symbol	Min.	Max.	Unit	Test Conditions
Collector-base breakdown voltage	$V_{(BR)CBO}$	−160	—	V	I_C = −100μA
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	−150	—	V	I_C = −10mA*
Emitter-base breakdown voltage	$V_{(BR)EBO}$	−5	—	V	I_E = −100μA
Collector cut-off current	I_{CBO}	— —	−0.1 −10	μA μA	V_{CB} = −140V V_{CB} = −140V T_{AMB} = 100°C
Emitter cut-off current	I_{EBO}	—	−0.1	μA	V_{EB} = −4V
Collector-emitter saturation voltage	$V_{CE(sat)}$	—	−0.3	V	I_C = −100mA* I_B = −10mA
Base-emitter saturation voltage	$V_{BE(sat)}$	—	−1.0	V	I_C = −100mA* I_B = −10mA
Base-emitter turn-on voltage	$V_{BE(on)}$	—	−1.0	V	I_C = −100mA* V_{CE} = −10V
Static forward current transfer ratio	h_{FE}	50 50	— 300		I_C = −10mA V_{CE} = −10V I_C = −300mA* V_{CE} = −10V
Transition frequency	f_T	100	—	MHz	I_C = −50mA V_{CE} = −10V f = 100MHz
Output capacitance	C_{obo}	—	10	pF	V_{CB} = −10V f = 1MHz

*Measured under pulsed conditions. Pulse width = 300μs. Duty cycle ≤ 2%.

Devices are identified by a code on the body of the device

FMMT 555 555

PNP silicon medium power transistor

FMMT 576

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Collector-Base Voltage	V_{CBO}	−200	V
Collector-Emitter Voltage	V_{CEO}	−200	V
Emitter-Base Voltage	V_{EBO}	−5	V
Peak Pulse Current**	I_{CM}	−2	A
Continuous Collector Current	I_C	−1	A

ELECTRICAL CHARACTERISTICS (at $T_{amb} = 25°C$ unless otherwise stated)

Parameter	Symbol	Min.	Max.	Unit	Test Conditions
Collector-base breakdown voltage	$V_{(BR)CBO}$	−200	—	V	$I_C = -100\mu A$
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	−200	—	V	$I_C = -10mA$
Emitter-base breakdown voltage	$V_{(BR)EBO}$	−5	—	V	$I_E = -100\mu A$
Collector cut-off current	I_{CBO}	—	−100	nA	$V_{CB} = -160V$
Emitter cut-off current	I_{EBO}	—	−100	nA	$V_{EB} = -4V$
Collector-emitter saturation voltage	$V_{CE(sat)}$	—	−0.3	V	$I_C = -100mA$,* $I_B = -10mA$
Base-emitter saturation voltage	$V_{BE(sat)}$	—	−1.0	V	$I_C = -100mA$,* $I_B = -10mA$
Static forward current transfer ratio	h_{FE}	50 50	— 300		$I_C = -10mA$, $V_{CE} = -10V$ $I_C = -300mA$,* $V_{CE} = -10V$
Base-emitter turn-on voltage	$V_{BE(on)}$	—	−1.0	V	$I_C = -100mA$,* $V_{CE} = -10V$
Transition frequency	f_T	100	—	MHz	$I_C = -50mA$, $V_{CE} = -10V$ $f = 100MHz$

*Measured under pulsed conditions. Pulse width = 300μs. Duty cycle ≤ 2%.

Devices are identified by a code on the body of the device

FMMT 576 576

PNP silicon medium power transistor

FMMT 589

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	FMMT 589	Unit
Collector-Base Voltage	V_{CBO}	−50	V
Collector-Emitter Voltage	V_{CEO}	−30	V
Emitter-Base Voltage	V_{EBO}	−5	V
Peak Pulse Current**	I_{CM}	−2	A
Continuous Collector Current	I_C	−1	A
Base Current	I_B	−200	mA

ELECTRICAL CHARACTERISTICS (at $T_{amb} = 25°C$ unless otherwise stated)

Parameter	Symbol	Min.	Max.	Unit	Test Conditions
Collector-base breakdown voltage	$V_{(BR)CBO}$	−50	—	V	$I_C = -100\mu A$
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	−30	—	V	$I_C = -10mA$*
Emitter-base breakdown voltage	$V_{(BR)EBO}$	−5	—	V	$I_E = -100\mu A$
Collector cut-off current	I_{CBO}	—	−100	nA	$V_{CB} = -30V$
Emitter cut-off current	I_{EBO}	—	−100	nA	$V_{EB} = -4V$
Collector-emitter cut-off current	I_{CES}	—	−100	nA	$V_{CES} = -30V$
Collector-emitter saturation voltage	$V_{CE(sat)}$	— —	−0.35 −0.65	V V	$I_C = -1A$, $I_B = -0.1A$* $I_C = -2A$, $I_B = -0.2A$*
Base-emitter saturation voltage	$V_{BE(sat)}$	—	−1.2	V	$I_C = -1A$, $I_B = -0.1A$*
Base-emitter turn-on voltage	$V_{BE(on)}$	—	−1.1	V	$I_C = -1A$, $V_{CE} = -2V$*
Static forward current transfer ratio	h_{FE}	100 100 80 40	— 300 — —		$I_C = -1mA$ $I_C = -500mA$* $I_C = -1A$* $I_C = -2A$* } $V_{CE} = -2V$
Transition frequency	f_T	100	—	MHz	$I_C = -100mA$, $V_{CE} = -5V$ $f = 100MHz$
Output capacitance	C_{obo}	—	15	pF	$V_{CB} = -10V$, $f = 1MHz$

*Measured under pulsed conditions. Pulse width = 300μs. Duty cycle ≤ 2%.

Devices are identified by a code on the body of the device

FMMT 589 589

PNP silicon medium power transistor

FMMT 591

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	FMMT 591	Unit
Collector-Base Voltage	V_{CBO}	−80	V
Collector-Emitter Voltage	V_{CEO}	−60	V
Emitter-Base Voltage	V_{EBO}	−5	V
Peak Pulse Current**	I_{CM}	−2	A
Continuous Collector Current	I_C	−1	A
Base Current	I_B	−200	mA

ELECTRICAL CHARACTERISTICS (at T_{amb} = 25°C unless otherwise stated)

Parameter	Symbol	Min.	Max.	Unit	Test Conditions
Collector-base breakdown voltage	$V_{(BR)CBO}$	−80	—	V	I_C = −100μA
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	−60	—	V	I_C = −10mA*
Emitter-base breakdown voltage	$V_{(BR)EBO}$	−5	—	V	I_E = −100μA
Collector cut-off current	I_{CBO}	—	−100	nA	V_{CB} = −60V
Emitter cut-off current	I_{EBO}	—	−100	nA	V_{EB} = −4V
Collector-emitter cut-off current	I_{CES}	—	−100	nA	V_{CES} = −60V
Collector-emitter saturation voltage	$V_{CE(sat)}$	— —	−0.3 −0.6	V V	I_C = −500mA, I_B = −50mA* I_C = −1A, I_B = −0.1A*
Base-emitter saturation voltage	$V_{BE(sat)}$	—	−1.2	V	I_C = −1A, I_B = −0.1A*
Base-emitter turn-on voltage	$V_{BE(on)}$	—	−1.0	V	I_C = −1A, V_{CE} = −5V*
Static forward current transfer ratio	h_{FE}	100 100 80 15	— 300 — —		I_C = −1mA I_C = −500mA* I_C = −1A* I_C = −2A* } V_{CE} = −5V
Transition frequency	f_T	150	—	MHz	I_C = −50mA, V_{CE} = −10V f = 100MHz
Output capacitance	C_{obo}	—	10	pF	V_{CB} = −10V, f = 1MHz

*Measured under pulsed conditions. Pulse width = 300μs. Duty cycle ≤2%.

Devices are identified by a code on the body of the device

FMMT 591 591

PNP silicon medium power transistor

FMMT 591A

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	FMMT 591A	Unit
Collector-Base Voltage	V_{CBO}	−40	V
Collector-Emitter Voltage	V_{CEO}	−40	V
Emitter-Base Voltage	V_{EBO}	−5	V
Peak Pulse Current**	I_{CM}	−2	A
Continuous Collector Current	I_C	−1	A
Base Current	I_B	−200	mA

ELECTRICAL CHARACTERISTICS (at T_{amb} = 25°C unless otherwise stated)

Parameter	Symbol	Min.	Max.	Unit	Test Conditions
Collector-base breakdown voltage	$V_{(BR)CBO}$	−40	—	V	I_C = −100μA
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	−40	—	V	I_C = −10mA*
Emitter-base breakdown voltage	$V_{(BR)EBO}$	−5	—	V	I_E = −100μA
Collector cut-off current	I_{CBO}	—	−100	nA	V_{CB} = −30V
Emitter cut-off current	I_{EBO}	—	−100	nA	V_{EB} = −4V
Collector-emitter cut-off current	I_{CES}	—	−100	nA	V_{CES} = −30V
Collector-emitter saturation voltage	$V_{CE(sat)}$	— — —	−0.2 −0.35 −0.5	V V V	I_C = −100mA, I_B = −1mA* I_C = −500mA, I_B = −20mA* I_C = −1A, I_B = −100mA*
Base-emitter saturation voltage	$V_{BE(sat)}$	—	−1.1	V	I_C = −1A, I_B = −50mA*
Base-emitter turn-on voltage	$V_{BE(on)}$	—	−1.0	V	I_C = −1A, V_{CE} = −5V*
Static forward current transfer ratio	h_{FE}	300 300 250 160 30	— 800 —		I_C = −1mA I_C = −100mA* I_C = −500mA* I_C = −1A* I_C = −2A* } V_{CE} = −5V
Transition frequency	f_T	150	—	MHz	I_C = −50mA, V_{CE} = −10V f = 100MHz
Output capacitance	C_{obo}	—	10	pF	V_{CB} = −10V, f = 1MHz

*Measured under pulsed conditions. Pulse width = 300μs. Duty cycle ≤ 2%.

Devices are identified by a code on the body of the device

FMMT 591A 91A

PNP silicon medium power transistor

FMMT 593

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	FMMT 593	Unit
Collector-Base Voltage	V_{CBO}	−120	V
Collector-Emitter Voltage	V_{CEO}	−100	V
Emitter-Base Voltage	V_{EBO}	−5	V
Peak Pulse Current**	I_{CM}	−2	A
Continuous Collector Current	I_C	−1	A
Base Current	I_B	−200	mA

ELECTRICAL CHARACTERISTICS (at $T_{amb} = 25°C$ unless otherwise stated)

Parameter	Symbol	Min.	Max.	Unit	Test Conditions
Collector-base breakdown voltage	$V_{(BR)CBO}$	−120	—	V	$I_C = -100\mu A$
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	−100	—	V	$I_C = -10mA$*
Emitter-base breakdown voltage	$V_{(BR)EBO}$	−5	—	V	$I_E = -100\mu A$
Collector cut-off current	I_{CBO}	—	−100	nA	$V_{CB} = -100V$
Emitter cut-off current	I_{EBO}	—	−100	nA	$V_{EB} = -4V$
Collector-emitter cut-off current	I_{CES}	—	−100	nA	$V_{CES} = -100V$
Collector-emitter saturation voltage	$V_{CE(sat)}$	— —	−0.2 −0.3	V V	$I_C = -250mA$, $I_B = -25mA$* $I_C = -500mA$, $I_B = -50mA$*
Base-emitter saturation voltage	$V_{BE(sat)}$	—	−1.1	V	$I_C = -500mA$, $I_B = -50mA$*
Base-emitter turn-on voltage	$V_{BE(on)}$	—	−1.0	V	$I_C = -500mA$, $V_{CE} = -5V$*
Static forward current transfer ratio	h_{FE}	100 100 100 50	— — 300 —		$I_C = -1mA$ $I_C = -250mA$* $I_C = -500mA$* $I_C = -1A$* } $V_{CE} = -5V$
Transition frequency	f_T	150	—	MHz	$I_C = -50mA$, $V_{CE} = -10V$ $f = 100MHz$
Output capacitance	C_{obo}	—	10	pF	$V_{CB} = -10V$, $f = 1MHz$

*Measured under pulsed conditions. Pulse width = 300μs. Duty cycle ⩽2%.

Devices are identified by a code on the body of the device

FMMT 593 593

PNP silicon medium power transistor

FMMT 596

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	FMMT 596	Unit
Collector-Base Voltage	V_{CBO}	−220	V
Collector-Emitter Voltage	V_{CEO}	−200	V
Emitter-Base Voltage	V_{EBO}	−5	V
Peak Pulse Current	I_{CM}	−1	A
Continuous Collector Current	I_C	−0.5	A
Base Current	I_B	−200	mA

ELECTRICAL CHARACTERISTICS (at T_{amb} = 25°C unless otherwise stated)

Parameter	Symbol	Min.	Max.	Unit	Test Conditions
Collector-base breakdown voltage	$V_{(BR)CBO}$	−220	—	V	I_C = −100μA
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	−200	—	V	I_C = −10mA*
Emitter-base breakdown voltage	$V_{(BR)EBO}$	−5	—	V	I_E = −100μA
Collector cut-off current	I_{CBO}	—	−100	nA	V_{CB} = −200V
Emitter cut-off current	I_{EBO}	—	−100	nA	V_{EB} = −4V
Collector-emitter cut-off current	I_{CES}	—	−100	nA	V_{CES} = −200V
Collector-emitter saturation voltage	$V_{CE(sat)}$	— —	−0.2 −0.35	V V	I_C = −100mA, I_B = −10mA I_C = −250mA, I_B = −25mA*
Base-emitter saturation voltage	$V_{BE(sat)}$	—	−1.0	V	I_C = −250mA, I_B = −25mA*
Base-emitter turn-on voltage	$V_{BE(on)}$	—	−0.9	V	I_C = −250mA, V_{CE} = −10V*
Static forward current transfer ratio	h_{FE}	100 100 100 40	— — 300 —		I_C = −1mA I_C = −100mA* I_C = −250mA* I_C = −500mA* } V_{CE} = −10V
Transition frequency	f_T	150	—	MHz	I_C = −50mA, V_{CE} = −10V f = 100MHz
Output capacitance	C_{obo}	—	10	pF	V_{CB} = −10V, f = 1MHz

*Measured under pulsed conditions. Pulse width = 300μs. Duty cycle ≤ 2%.

Devices are identified by a code on the body of the device

FMMT 596 596

PNP silicon medium power transistor

FMMT 597

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	FMMT 597	Unit
Collector-Base Voltage	V_{CBO}	−300	V
Collector-Emitter Voltage	V_{CEO}	−300	V
Emitter-Base Voltage	V_{EBO}	−5	V
Peak Pulse Current**	I_{CM}	−1	A
Continuous Collector Current	I_C	−0.5	A
Base Current	I_B	−200	mA

ELECTRICAL CHARACTERISTICS (at T_{amb} = 25°C unless otherwise stated)

Parameter	Symbol	Min.	Max.	Unit	Test Conditions
Collector-base breakdown voltage	$V_{(BR)CBO}$	−300	—	V	I_C = −100μA
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	−300	—	V	I_C = −10mA*
Emitter-base breakdown voltage	$V_{(BR)EBO}$	−5	—	V	I_E = −100μA
Collector cut-off current	I_{CBO}	—	−100	nA	V_{CB} = −250V
Emitter cut-off current	I_{EBO}	—	−100	nA	V_{EB} = −4V
Collector-emitter cut-off current	I_{CES}	—	−100	nA	V_{CES} = −250V
Collector-emitter saturation voltage	$V_{CE(sat)}$	— —	−0.25 −0.25	V V	I_C = −50mA, I_B = −5mA I_C = −100mA, I_B = −20mA*
Base-emitter saturation voltage	$V_{BE(sat)}$	—	−1.0	V	I_C = −100mA, I_B = −20mA*
Base-emitter turn-on voltage	$V_{BE(on)}$	—	−0.85	V	I_C = −100mA, V_{CE} = −10V*
Static forward current transfer ratio	h_{FE}	100 100 100	— 300 —		I_C = −1mA I_C = −50mA I_C = −100mA* } V_{CE} = −10V
Transition frequency	f_T	75	—	MHz	I_C = −50mA, V_{CE} = −10V f = 100MHz
Output capacitance	C_{obo}	—	10	pF	V_{CB} = −10V, f = 1MHz

*Measured under pulsed conditions. Pulse width = 300μs. Duty cycle ≤ 2%.

Devices are identified by a code on the body of the device

FMMT 597 597

NPN silicon planar VHF/UHF transistors

FMMT918

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Collector-Base Voltage	V_{CBO}	30	V
Collector-Emitter Voltage	V_{CEO}	15	V
Emitter-Base Voltage	V_{EBO}	3	V
Collector Current	I_C	100	mA

CHARACTERISTICS (at 25°C ambient temperature unless otherwise stated).

Parameter	Symbol	Min.	Max.	Unit	Conditions
Collector-base breakdown voltage	$V_{(BR)CBO}$	30	—	V	I_C=1.0μA, I_E=0
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	15	—	V	I_C=3mA, I_B=0
Emitter-base breakdown voltage	$V_{(BR)EBO}$	3	—	V	I_E=10μA, I_C=0
Collector-base cut-off current	I_{CBO}	—	0.05	μA	V_{CB}=15V, I_E=0
Collector-emitter saturation voltage	$V_{CE(sat)}$	—	0.4	V	I_C=10mA, I_B=1mA
Base-emitter saturation voltage	$V_{BE(sat)}$	—	1.0	V	I_C=10mA, I_B=1mA
Static forward current transfer ratio	h_{FE}	20	—		I_C=3mA, V_{CE}=1V
Transition frequency	f_T	600	—	MHz	I_C=4mA, V_C=10V f=100MHz
Output capacitance	C_{obo}	— —	3.0 1.7	pF pF	V_{CB}=0V, f=1MHz V_{CB}=10V, f=1MHz
Input capacitance	C_{ibo}	—	1.6	pF	V_{EB}=0.5V, f=1MHz
Noise figure	N	—	6.0	dB	V_{CE}=6V, I_C=1mA f=60MHz, R_G=400Ω
Common emitter power gain	G_{pe}	Typical 15		dB	I_C=6mA, V_{CB}=12V f=200MHz

Devices are identified by a code on the body of the device

FMMT918 . . . . . 3B

NPN silicon planar general purpose switching transistors

FMMT2222
FMMT2222A

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	FMMT2222	FMMT2222A	Unit
Collector-Base Voltage	V_{CBO}	60	75	V
Collector-Emitter Voltage	V_{CEO}	30	40	V
Emitter-Base Voltage	V_{EBO}	5	6	V
Continuous Collector Current	I_C	600	600	mA

CHARACTERISTICS (at 25°C ambient temperature unless otherwise stated).

Parameter	Symbol	FMMT2222		FMMT2222A		Unit	Conditions
		Min.	Max.	Min.	Max.		
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	30	—	40	—	V	$I_C = 10mA$ $I_B = 0$
Collector-base breakdown voltage	$V_{(BR)CBO}$	60	—	75	—	V	$I_C = 10\mu A$ $I_E = 0$
Emitter-base breakdown voltage	$V_{(BR)EBO}$	5	—	6	—	V	$I_E = 10\mu A$ $I_C = 0$
Collector-emitter cut-off current	I_{CEX}	—	—	—	10	nA	$V_{CE} = 60V$ $V_{EB(off)} = 3V$
Collector-base cut-off current	I_{CBO}	—	10	—	—	nA	$V_{CB} = 50V$, $I_E = 0$
		—	—	—	10	nA	$V_{CB} = 60V$, $I_E = 0$
		—	10	—	—	μA	$V_{CB} = 50V$, $I_E = 0$ $T_{amb} = 150°C$
		—	—	—	10	μA	$V_{CB} = 60V$, $I_E = 0$ $T_{amb} = 150°C$
Emitter-base cut-off current	I_{EBO}	—	—	—	10	nA	$V_{EB} = 3V$ $I_C = 0$
Static forward current transfer ratio	h_{FE}	35	—	35	—		$I_C = 0.1mA$ $V_{CE} = 10V$*
		50	—	50	—		$I_C = 1mA$ $V_{CE} = 10V$
		75	—	75	—		$I_C = 10mA$ $V_{CE} = 10V$*
		35	—	35	—		$I_C = 10mA$ $V_{CE} = 10V$ $T_{amb} = -55°C$
		100	300	100	300		$I_C = 150mA$ $V_{CE} = 10V$*
		50	—	50	—		$I_C = 150mA$ $V_{CE} = 1V$*
		30	—	40	—		$I_C = 500mA$ $V_{CE} = 10V$*

*Measured under pulsed conditions. Pulse width = 300μs. Duty cycle = 2%.

CHARACTERISTICS (cont.).

Parameter	Symbol	FMMT2222		FMMT2222A		Unit	Conditions
		Min.	Max.	Min.	Max.		
Collector-emitter saturation voltage	$V_{CE(sat)}$	—	0.4	—	0.3	V	I_C=150mA I_B=15mA*
		—	1.6	—	1.0	V	I_C=500mA I_B=50mA*
Base-emitter saturation voltage	$V_{BE(sat)}$	0.6	2.0	0.6	1.2	V	I_C=150mA I_B=15mA*
		—	2.6	—	2.0	V	I_C=500mA I_B=50mA*
Transition frequency	f_T	250	—	300	—	MHz	I_C=20mA V_{CE}=20V f=100MHz
Output capacitance	C_{OBO}	—	8	—	8	pF	V_{CB}=10V I_E=0 f=140KHz
Input capacitance	C_{ibo}	—	30	—	25	pF	V_{EB}=0.5V I_C=0 f=140KHz
Noise figure	N	—	—	—	4	dB	I_C=200μA V_{CE}=5V R_g=2kΩ f=1KHz △f=200Hz

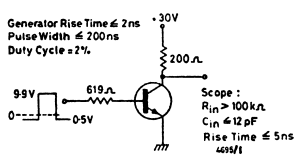
*Measured under pulsed conditions. Pulse width=300μs. Duty cycle=2%.

SWITCHING CHARACTERISTICS (at 25°C ambient temperature).

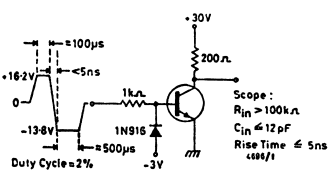
Parameter	Symbol	FMMT2222	FMMT2222A	Unit	Conditions
		Typical	Maximum		
Delay time	t_d	10	10	ns	V_{CC}=30V, $V_{BE(off)}$=0.5V I_C=150mA, I_{B1}=15mA (See fig. 1)
Rise time	t_r	25	25	ns	
Storage time	t_s	225	225	ns	V_{CC}=30V, I_C=150mA I_{B1}=I_{B2}=15mA (See Fig. 2)
Fall time	t_f	60	60	ns	

CIRCUITS FOR MEASURING SWITCHING TIMES

DELAY AND RISE TIME
Equivalent test circuit



STORAGE TIME AND FALL TIME
Equivalent test circuit



Devices are identified by a code on the body of the device

FMMT2222	1B
FMMT2222A	1P
FMMT2222R	2P
FMMT2222AR	3P

NPN silicon planar high speed switching transistor

FMMT2369

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Collector-Base Voltage	V_{CBO}	40	√
Collector-Emitter Voltage	V_{CES}	40	V
Collector-Emitter Voltage	V_{CEO}	15	V
Emitter-Base Voltage	V_{EBO}	4.5	V
Continuous Collector Current	I_C	200	mA

CHARACTERISTICS (at 25°C ambient temperature unless otherwise stated).

Parameter	Symbol	Min.	Max.	Unit	Conditions
Collector-base breakdown voltage	$V_{(BR)CBO}$	40	—	V	$I_C = 10\mu A$, $I_E = 0$
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	15	—	V	$I_C = 10mA$, $I_B = 0$*
	$V_{(BR)CES}$	40	—	V	$I_C = 10\mu A$, $V_{BE} = 0$
Emitter-base breakdown voltage	$V_{(BR)EBO}$	4.5	—	V	$I_E = 10\mu A$, $I_C = 0$
Collector-base cut-off current	I_{CBO}	—	0.4	μA	$V_{CB} = 20V$, $I_E = 0$
Static forward current transfer ratio	h_{FE}	40 20 20	120 — —		$I_C = 10mA$, $V_{CE} = 1V$* $I_C = 10mA$, $V_{CE} = 1V$ $T_{amb} = -55°C$ $I_C = 100mA$ $V_{CE} = 2V$*
Collector-emitter saturation voltage	$V_{CE(sat)}$	—	0.25	V	$I_C = 10mA$, $I_B = 1mA$*
Base-emitter saturation voltage	$V_{BE(sat)}$	0.7	0.85	V	$I_C = 10mA$, $I_B = 1mA$*
Output capacitance	C_{obo}	—	4	pF	$V_{CB} = 5V$, $I_E = 0$ $f = 140kHz$

*Measured under pulsed conditions. Pulse width = 300μs. Duty cycle = 2%.

SWITCHING CHARACTERISTICS (at 25°C ambient temperature).

Parameter	Symbol	Min.	Max.	Unit	Conditions
Turn-on time	t_{on}	—	12	ns	$V_{CC} = 3V$, $V_{BE(off)} = 1.5V$ $I_C = 10mA$, $I_{B1} = 3mA$ (See fig. 1)
Turn-off time	t_{off}	—	18	ns	$V_{CC} = 3V$, $I_C = 10mA$, $I_{B1} = 3mA$ $I_{B2} = 1.5mA$ (See Fig. 2)
Storage time	t_s	—	13	ns	$I_{B1} = I_{B2} = I_C = 10mA$ (See Fig. 3)

CIRCUITS FOR MEASURING SWITCHING TIMES

TURN-ON TIME

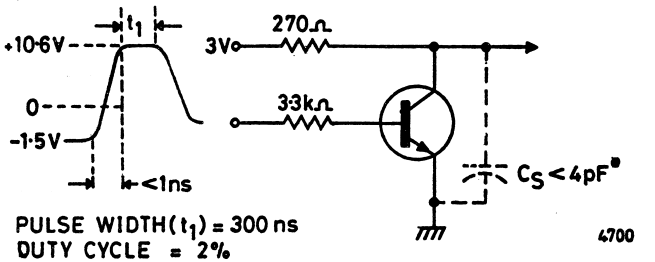


Fig. 1

TURN-OFF TIME

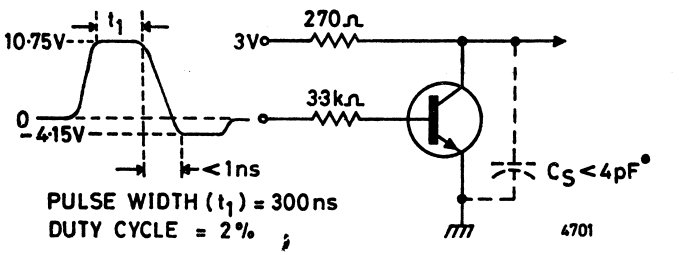


Fig. 2

STORAGE TEST CIRCUIT

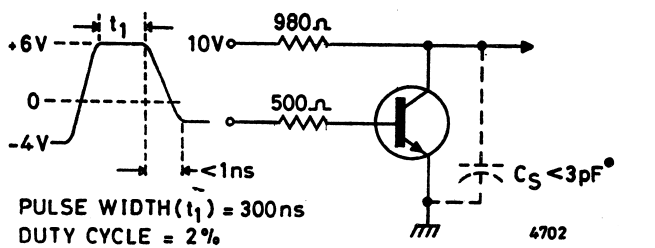


Fig. 3

● Total Shunt Capacitance of Test Jig and Connectors

Devices are identified by a code on the body of the device

FMMT2369	1J
FMMT2369R	9R

NPN silicon planar high speed switching transistor

FMMT2369A

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Collector-Base Voltage	V_{CBO}	40	V
Collector-Emitter Voltage	V_{CES}	40	V
Collector-Emitter Voltage	V_{CEO}	15	V
Emitter-Base Voltage	V_{EBO}	4.5	V
Continuous Collector Current	I_C	200	mA

CHARACTERISTICS (at 25°C ambient temperature unless otherwise stated).

Parameter	Symbol	Min.	Max.	Unit	Conditions
Collector-base breakdown voltage	$V_{(BR)CBO}$	40	—	V	$I_C = 10\mu A$, $I_E = 0$
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	15	—	V	$I_C = 10mA$, $I_B = 0$*
	$V_{(BR)CES}$	40	—	V	$I_C = 10\mu A$, $V_{BE} = 0$
Emitter-base breakdown voltage	$V_{(BR)EBO}$	4.5	—	V	$I_E = 10\mu A$, $I_C = 0$
Collector-base cut-off current	I_{CBO}	—	25	nA	$V_{CB} = 20V$, $I_E = 0$
Static forward current transfer ratio	h_{FE}	40 20	120 —		$I_C = 10mA$, $V_{CE} = 1V$* $I_C = 100mA$, $V_{CE} = 1V$
Collector-emitter saturation voltage	$V_{CE(sat)}$	—	0.2	V	$I_C = 10mA$, $I_B = 1mA$*
Base-emitter saturation voltage	$V_{BE(sat)}$	0.7	0.85	V	$I_C = 10mA$, $I_B = 1mA$*
Output capacitance	C_{obo}	—	4	pF	$V_{CB} = 5V$, $I_E = 0$ $f = 140kHz$

*Measured under pulsed conditions. Pulse width = 300μs. Duty cycle = 2%.

SWITCHING CHARACTERISTICS (at $T_{amb} = 25°C$).

Parameter	Symbol	Min.	Max.	Unit	Conditions
Turn-on time	t_{on}	—	12	ns	$V_{CC} = 3V$, $V_{BE(off)} = 1.5V$ $I_C = 10mA$, $I_{B1} = 3mA$ (See fig. 1)
Turn-off time	t_{off}	—	18	ns	$V_{CC} = 3V$, $I_C = 10mA$, $I_{B1} = 3mA$ $I_{B2} = 1.5mA$ (See Fig. 2)
Storage time	t_s	—	13	ns	$I_{B1} = I_{B2} = I_C = 10mA$ (See Fig. 3)

CIRCUITS FOR MEASURING SWITCHING TIMES

TURN-ON TIME

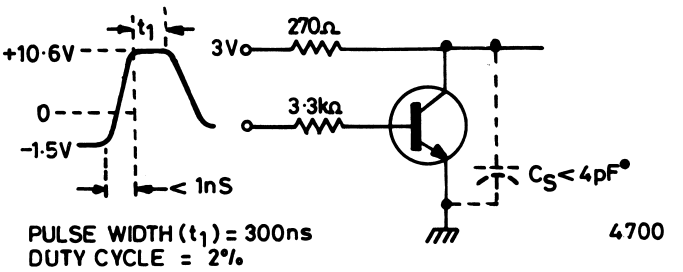


Fig. 1

TURN-OFF TIME

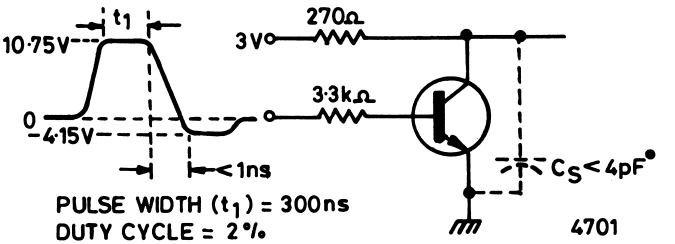


Fig. 2

STORAGE TEST CIRCUIT

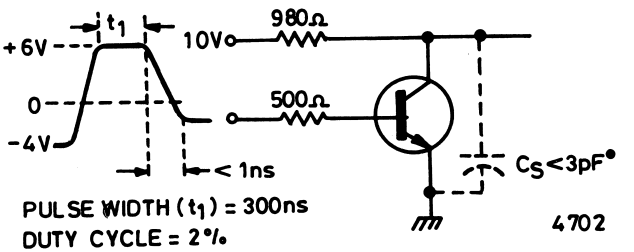


Fig. 3

● Total Shunt Capacitance of Test Jig and Connectors

Devices are identified by a code on the body of the device

FMMT2369A	P5
FMMT2369AR	9A

NPN silicon planar small signal transistor

FMMT2484

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	FMMT2484	Unit
Collector-Base Voltage	V_{CBO}	60	V
Collector-Emitter Voltage (I_C = 2mA)	V_{CEO}	60	V
Emitter-Base Voltage	V_{EBO}	6	V
Collector Current	I_C	50	mA
Peak Collector Current	I_{CM}	200	mA

CHARACTERISTICS (at T_j = 25°C unless otherwise stated).

Parameter	Symbol	Min.	Max.	Unit	Conditions
Collector-base breakdown voltage	$V_{(BR)CBO}$	60	—	V	I_C = 10μA
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	60	—	V	I_C = 10mA
Emitter-base breakdown voltage	$V_{(BR)EBO}$	6	—	V	I_E = 10μA
Collector cut-off current	I_{CBO}	— —	10 10	nA μA	V_{CB} = 45V V_{CB} = 45V, T_{amb} = 150°C
Emitter cut-off current	I_{EBO}	—	10	nA	V_{BE} = 5V
Static forward current transfer ratio	h_{FE}	30 100 20 175 200 250 —	— 500 — — — — 800		I_C = 1μA, V_{CE} = 5V I_C = 10μA, V_{CE} = 5V I_C = 10μA, V_{CE} = 5V T_{amb} = 55°C I_C = 100μA, V_{CE} = 5V I_C = 500μA, V_{CE} = 5V I_C = 1mA, V_{CE} = 5V I_C = 10mA, V_{CE} = 5V
Base-emitter voltage	V_{BE}	—	0.95	V	I_C = 1mA, V_{CE} = 5V
Collector-emitter saturation voltage	$V_{CE(sat)}$	—	0.35	V	I_C = 1mA, I_B = 100μA
Output capacitance	C_{obo}	—	6	pF	V_{CB} = 5V, f = 140kHz
Input capacitance	C_{ibo}	—	6	pF	V_{BE} = 0.5V, f = 140kHz
Noise figure	N	—	3	db	I_C = 200μA, V_{CE} = 5V R_g = 2kΩ, f = 1kHz f = 2000Hz
		—	3	dB	I_C = 200μA, V_{CE} = 5V R_g = 2kΩ, f = 30Hz to 15kHz at −3dB points

Devices are identified by a code on the body of the device

FMMT2484 . . . . . 4G

PNP silicon planar general purpose switching transistors

FMMT2907
FMMT2907A

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	FMMT2907	FMMT2907A	Unit
Collector-Base Voltage	V_{CBO}	−60	−60	V
Collector-Emitter Voltage	V_{CEO}	−40	−60	V
Emitter-Base Voltage	V_{EBO}	−5	−5	V
Continuous Collector Current	I_C	−600	−600	mA

CHARACTERISTICS (at 25°C ambient temperature unless otherwise stated).

Parameter	Symbol	FMMT2907		FMMT2907A		Unit	Conditions
		Min.	Max.	Min.	Max.		
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	−40	—	−60	—	V	$I_C = -10mA$ $I_B = 0$*
Collector-base breakdown voltage	$V_{(BR)CBO}$	−60	—	−60	—	V	$I_C = -10\mu A$ $I_E = 0$
Emitter-base breakdown voltage	$V_{(BR)EBO}$	−5	—	−5	—	V	$I_E = -10\mu A$ $I_C = 0$
Collector-emitter cut-off current	I_{CEX}	—	−50	—	−50	nA	$V_{CE} = -30V$ $V_{BE} = -0.5V$
Collector-base cut-off current	I_{CBO}	— —	−20 −20	— —	−10 −10	nA μA	$V_{CB} = -50V$, $I_E = 0$ $V_{CB} = -50V$, $I_E = 0$ $T_{amb} = 150°C$
Base cut-off current	I_B	—	−50	—	−50	nA	$V_{CE} = -30V$ $V_{BE} = -0.5V$
Static forward current transfer ratio	h_{FE}	35 50 75 100 30	— — — 300 —	75 100 100 100 50	— — — 300 —		$I_C = -0.1mA$, $V_{CE} = -10V$ $I_C = -1mA$, $V_{CE} = -10V$ $I_C = -10mA$, $V_{CE} = -10V$ $I_C = -150mA$, $V_{CE} = -10V$* $I_C = -500mA$, $V_{CE} = -10V$*
Collector-emitter saturation voltage	$V_{CE(sat)}$	— —	−0.4 −1.6	— —	−0.4 −1.6	V V	$I_C = -150mA$, $I_B = -15mA$* $I_C = -500mA$, $I_B = -50mA$*
Base-emitter saturation voltage	$V_{BE(sat)}$	— —	−1.3 −2.6	— —	−1.3 −2.6	V V	$I_C = -150mA$, $I_B = -15mA$* $I_C = -500mA$, $I_B = -50mA$*

*Measured under pulsed conditions. Pulse width = 200μs. Duty cycle = 1%.

CHARACTERISTICS (cont.).

Parameter	Symbol	FMMT2907		FMMT2907A		Unit	Conditions
		Min.	Max.	Min.	Max.		
Transition frequency	f_T	200	—	200		MHz	$I_C = -50mA$ $V_{CE} = -20V$ $f = 100MHz$
Output capacitance	C_{OBO}	—	8	—	8	pF	$V_{CB} = -10V$ $I_E = 0$ $f = 100KHz$
Input capacitance	C_{ibo}	—	30	—	30	pF	$V_{BE} = -2V$ $I_C = 0$ $f = 100KHz$

SWITCHING CHARACTERISTICS (at 25°C ambient temperature).

Parameter	Symbol	Typical	Maximum	Unit	Conditions
Turn-on time	t_{on}	26	50	ns	$V_{CC} = -30V$, $I_C = -150mA$ $I_{B1} = -15mA$ (See Fig. 1)
Turn-off time	t_{off}	70	110	ns	$V_{CC} = -6V$, $I_C = -150mA$ $I_{B1} = I_{B2} = -15mA$ (See Fig. 2)

CIRCUITS FOR MEASURING SWITCHING TIMES

TURN-ON TIME

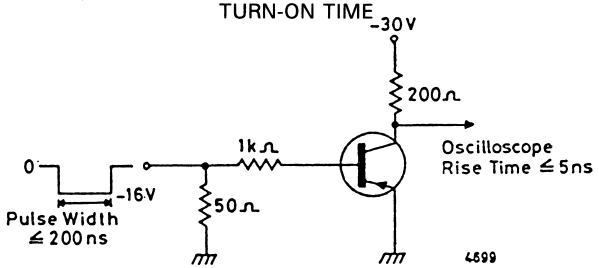


Fig. 1

TURN-OFF TIME

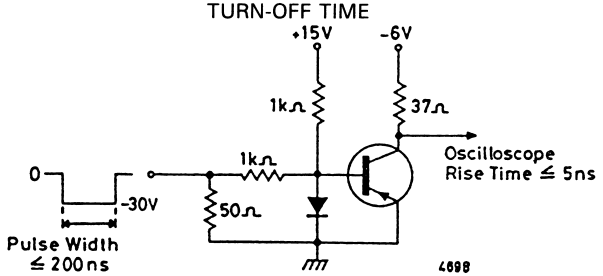


Fig. 2

Devices are identified by a code on the body of the device

FMMT2907	2B
FMMT2907A	2F
FMMT2907R	4P
FMMT2907AR	5P

NPN silicon planar general purpose switching transistors

FMMT3903
FMMT3904

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Collector-Base Voltage	V_{CBO}	60	V
Collector-Emitter Voltage	V_{CEO}	40	V
Emitter-Base Voltage	V_{EBO}	6	V
Continuous Collector Current	I_C	200	mA

CHARACTERISTICS (at 25°C ambient temperature unless otherwise stated).

Parameter	Symbol	FMMT3903		FMMT3904		Unit	Conditions
		Min.	Max.	Min.	Max.		
Collector-base breakdown voltage	$V_{(BR)CBO}$	60	—	60	—	V	$I_C = 10\mu A$, $I_E = 0$
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	40	—	40	—	V	$I_C = 1mA$, $I_B = 0$*
Emitter-base breakdown voltage	$V_{(BR)EBO}$	6	—	6	—	V	$I_E = 10\mu A$, $I_C = 0$
Collector cut-off current	I_{CEX}	—	50	—	50	nA	$V_{CE} = 30V$ $V_{EB(off)} = 3V$
Base cut-off current	I_{BEX}	—	50	—	50	nA	$V_{CE} = 30V$, $V_{EB(off)} = 3V$
Static forward current transfer ratio	h_{FE}	20 35 50 30 15	— — 150 — —	40 70 100 60 30	— — 300 — —		$I_C = 0.1mA$, $V_{CE} = 1V$* $I_C = 1mA$, $V_{CE} = 1V$* $I_C = 10mA$, $V_{CE} = 1V$* $I_C = 50mA$, $V_{CE} = 1V$* $I_C = 100mA$, $V_{CE} = 1V$*
Collector-emitter saturation voltage	$V_{CE(sat)}$	— —	0.2 0.3	— —	0.2 0.3	V V	$I_C = 10mA$, $I_B = 1mA$* $I_C = 50mA$, $I_B = 5mA$*
Base-emitter saturation voltage	$V_{BE(sat)}$	0.65 —	0.85 0.95	0.65 —	0.85 0.95	V V	$I_C = 10mA$, $I_B = 1mA$* $I_C = 50mA$, $I_B = 5mA$*
Transition frequency	f_T	250	—	300	—	MHz	$I_C = 10mA$, $V_{CE} = 20V$ $f = 100MHz$
Output capacitance	C_{OBO}	—	4	—	4	pF	$V_{CB} = 5V$, $I_E = 0$ $f = 100kHz$
Input capacitance	C_{ibo}	—	8	—	8	pF	$V_{BE} = 0.5V$, $I_C = 0$ $f = 100kHz$
Noise figure	N	—	6	—	5	dB	$I_C = 200\mu A$, $V_{CE} = 5V$ $R_g = 2k\Omega$ $f = 30Hz$ to $15kHz$ at $-3dB$ points

*Measured under pulsed conditions. Pulse width = 300μs. Duty cycle = 2%.

SWITCHING CHARACTERISTICS (at 25°C ambient temperature).

Parameter	Symbol	FMMT3903		FMMT3904		Unit	Conditions
		Min.	Max.	Min.	Max.		
Delay time	t_d	—	35	—	35	ns	V_{CC} = 3V, $V_{BE(off)}$ = 0.5V I_C = 10mA, I_{B1} = 1mA (See fig. 1)
Rise time	t_r	—	35	—	35	ns	
Storage time	t_s	—	175	—	200	ns	V_{CC} = 3V, I_C = 10mA I_{B1} = I_{B2} = 1mA (See Fig. 2)
Fall time	t_f	—	50	—	50	ns	

CIRCUITS FOR MEASURING SWITCHING TIMES

DELAY AND RISE TIME
Equivalent test circuit

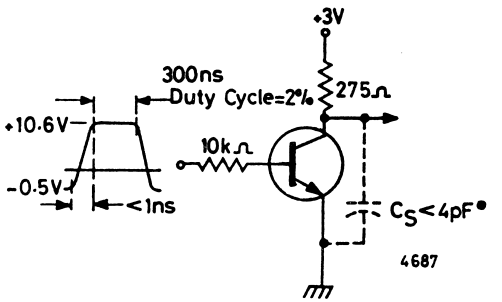


Fig. 1

STORAGE AND FALL TIME
Equivalent test circuit

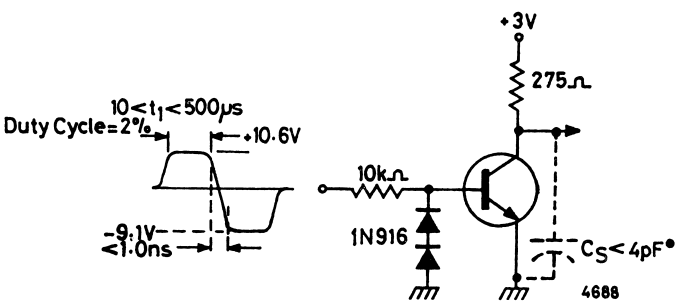


Fig. 2

● Total shunt capacitance of test jig and connectors

Devices are identified by a code on the body of the device

FMMT3903 . . . . . 1W
FMMT3904 . . . . . 1A

PNP silicon planar general purpose switching transistors

FMMT3905
FMMT3906

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Collector-Base Voltage	V_{CBO}	−40	V
Collector-Emitter Voltage	V_{CEO}	−40	V
Emitter-Base Voltage	V_{EBO}	−5	V
Continuous Collector Current	I_C	−200	mA

CHARACTERISTICS (at 25°C ambient temperature unless otherwise stated).

Parameter	Symbol	FMMT3905		FMMT3906		Unit	Conditions
		Min.	Max.	Min.	Max.		
Collector-base breakdown voltage	$V_{(BR)CBO}$	−40	—	−40	—	V	$I_C = -10\mu A$, $I_E = 0$
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	−40	—	−40	—	V	$I_C = -1mA$, $I_B = 0$*
Emitter-base breakdown voltage	$V_{(BR)EBO}$	−5	—	−5	—	V	$I_E = -10\mu A$, $I_C = 0$
Collector cut-off current	I_{CEX}	—	−50	—	−50	nA	$V_{CE} = -30V$ $V_{BE(off)} = -3V$
Base cut-off current	I_{BEX}	—	−50	—	−50	nA	$V_{CE} = -30V$, $V_{BE(off)} = -3V$
Static forward current transfer ratio	h_{FE}	30 40 50 30 15	— — 150 — —	60 80 100 60 30	— — 300 — —		$I_C = -0.1mA$, $V_{CE} = -1V$ $I_C = -1mA$, $V_{CE} = -1V$ $I_C = -10mA$, $V_{CE} = -1V$ $I_C = -50mA$, $V_{CE} = -1V$ $I_C = -100mA$, $V_{CE} = -1V$
Collector-emitter saturation voltage	$V_{CE(sat)}$	— —	−0.25 −0.4	— —	−0.25 −0.4	V V	$I_C = -10mA$, $I_B = -1mA$ $I_C = -50mA$, $I_B = -5mA$
Base-emitter saturation voltage	$V_{BE(sat)}$	−0.65 —	−0.85 −0.95	−0.65 —	−0.85 −0.95	V V	$I_C = -10mA$, $I_B = -1mA$ $I_C = -50mA$, $I_B = -5mA$
Transition frequency	f_T	200	—	250	—	MHz	$I_C = -10mA$, $V_{CE} = -20V$ $f = 100MHz$
Output capacitance	C_{obo}	—	4.5	—	4.5	pF	$V_{CB} = -5V$, $I_E = 0$ $f = 100kHz$
Input capacitance	C_{ibo}	—	10	—	10	pF	$V_{BE} = -0.5V$, $I_C = 0$ $f = 100kHz$
Noise figure	N	—	5	—	4	dB	$I_C = -200\mu A$, $V_{CE} = -5V$ $R_g = 2k\Omega$ $f = 30Hz$ to $15kHz$ at −3dB points

*Measured under pulsed conditions. Pulse width = 300μs. Duty cycle = 2%.

SWITCHING CHARACTERISTICS (at 25°C ambient temperature).

Parameter	Symbol	FMMT3905		FMMT3906		Unit	Conditions
		Min.	Max.	Min.	Max.		
Delay time	t_d	—	35	—	35	ns	$V_{CC} = -3V$, $V_{BE(off)} = -0.5V$ $I_C = -10mA$, $I_{B1} = -1mA$ (See fig. 1)
Rise time	t_r	—	35	—	35	ns	
Storage time	t_s	—	200	—	225	ns	$V_{CC} = -3V$, $I_C = -10mA$ $I_{B1} = I_{B2} = -1mA$ (See Fig. 2)
Fall time	t_f	—	60	—	75	ns	

CIRCUITS FOR MEASURING SWITCHING TIMES

DELAY AND RISE TIME
Equivalent test circuit

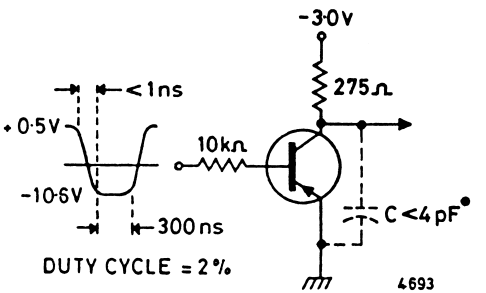


Fig. 1

STORAGE AND FALL TIME
Equivalent test circuit

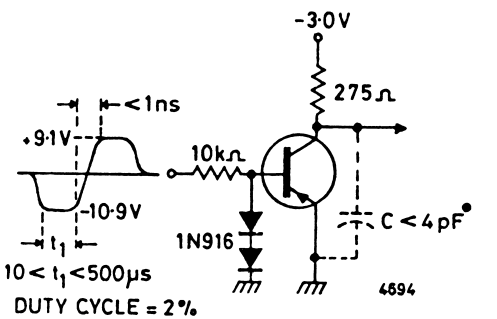


Fig. 2

● Total shunt capacitance of test jig and connectors

Devices are identified by a code on the body of the device

FMMT3905 . . . . . 2W
FMMT3906 . . . . . 2A

NPN silicon planar general purpose switching transistor

FMMT4123

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Collector-Base Voltage	V_{CBO}	40	V
Collector-Emitter Voltage	V_{CEO}	30	V
Emitter-Base Voltage	V_{EBO}	5	V
Continuous Collector Current	I_C	200	mA

CHARACTERISTICS (at $T_{amb} = 25°C$ unless otherwise stated).

Parameter	Symbol	Min.	Max.	Unit	Conditions
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	30	—	V	$I_C = 1mA$*
Collector-base breakdown voltage	$V_{(BR)CBO}$	40	—	V	$I_C = 10\mu A$
Emitter-base breakdown voltage	$V_{(BR)EBO}$	5	—	V	$I_E = 10\mu A$
Collector-base cut-off current	I_{CBO}	—	50	nA	$V_{CB} = 20V$
Emitter-base cut-off current	I_{EBO}	—	50	nA	$V_{EB} = 3V$
Static forward current transfer ratio	h_{FE}	50 25	150 —		$I_C = 2mA$, $V_{CE} = 1V$* $I_C = 50mA$, $V_{CE} = 1V$*
Collector-emitter saturation voltage	$V_{CE(sat)}$	—	0.3	V	$I_C = 50mA$, $I_B = 5mA$*
Base-emitter saturation voltage	$V_{BE(sat)}$	—	0.95	V	$I_C = 50mA$, $I_B = 5mA$*
Transition frequency	f_T	250	—	MHz	$V_{CE} = 20V$, $I_C = 10mA$ $f = 100MHz$
Output capacitance	C_{obo}	—	4	pF	$V_{CB} = 5V$, $f = 140kHz$
Input capacitance	C_{ibo}	—	8	pF	$V_{EB} = 0.5V$, $f = 140kHz$
Small signal current transfer ratio	h_{fe}	50	200		$I_C = 2mA$, $V_{CE} = 1V$, $f = 1kHz$
Noise figure	N	—	6	dB	$I_C = 200\mu A$, $V_{CE} = 5V$ $R_g 2k\Omega$, $f = 30Hz$ to $15kHz$ at 3dB points

SWITCHING CHARACTERISTICS (at $T_{amb} = 25°C$).

Parameter	Symbol	Typ.	Unit	Conditions
Delay time	t_d	24	ns	$V_{CC} = 3V$, $V_{BE(off)} = 0.5V$ $I_C = 10mA$, $I_{B1} = 1mA$
Rise time	t_r	13	ns	
Storage time	t_s	125	ns	$V_{CC} = 3V$, $I_C = 10mA$ $I_{B1} = I_{B2} = 1mA$
Fall time	t_f	11	ns	

*Measured under pulsed conditions. Pulse width = 300μs. Duty cycle = ⩽2%.

Devices are identified by a code on the body of the device

FMMT4123 . . . . . ZB

NPN silicon planar general purpose switching transistor

FMMT4124

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Collector-Base Voltage	V_{CBO}	30	V
Collector-Emitter Voltage	V_{CEO}	25	V
Emitter-Base Voltage	V_{EBO}	5	V
Continuous Collector Current	I_C	200	mA

CHARACTERISTICS (at 25°C ambient temperature unless otherwise stated).

Parameter	Symbol	Min.	Max.	Unit	Conditions
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	25	–	V	$I_C = 1mA$*
Collector-base breakdown voltage	$V_{(BR)CBO}$	30	–	V	$I_C = 10\mu A$
Emitter-base breakdown voltage	$V_{(BR)EBO}$	5	–	V	$I_E = 10\mu A$
Collector-base cut-off current	I_{CBO}	–	50	nA	$V_{CB} = 20V$
Emitter-base cut-off current	I_{EBO}	–	50	nA	$V_{BE} = 3V$
Static forward current transfer ratio	h_{FE}	120 60	360 –		$I_C = 2mA$, $V_{CE} = 1V$* $I_C = 50mA$, $V_{CE} = 1V$*
Collector-emitter saturation voltage	$V_{CE(sat)}$	–	0.3	V	$I_C = 50mA$, $I_B = 5mA$*
Base-emitter saturation voltage	$V_{BE(sat)}$	–	0.95	V	$I_C = 50mA$, $I_B = 5mA$*
Transition frequency	f_T	300	–	MHz	$V_{CE} = 20V$, $I_C = 10mA$ $f = 100MHz$
Output capacitance	C_{obo}	–	4	pF	$V_{CB} = 5V$, $f = 140kHz$
Input capacitance	C_{ibo}	–	8	pF	$V_{EB} = 0.5V$, $f = 140kHz$
Small signal current transfer ratio	h_{fe}	120	480		$I_C = 2mA$, $V_{CE} = 1V$, $f = 1kHz$
Noise figure	N	–	6	dB	$I_C = 200\mu A$, $V_{CE} = 5V$ Rg 2kΩ, f = 30Hz to 15kHz at 3dB points

SWITCHING CHARACTERISTICS (at 25°C ambient temperature).

Parameter	Symbol	Typ.	Unit	Conditions
Delay time	t_d	24	ns	$V_{CC} = 3V$, $V_{EB(off)} = 0.5V$ $I_C = 10mA$, $I_{B1} = 1mA$
Rise time	t_r	13	ns	
Storage time	t_s	125	ns	$V_{CC} = 3V$, $I_C = 10mA$ $I_{B1} = I_{B2} = 1mA$
Fall time	t_f	11	ns	

*Measured under pulsed conditions. Pulse width = 300μs. Duty cycle = ⩽2%.

Devices are identified by a code on the body of the device

FMMT4124 . . . . . ZC

PNP silicon planar general purpose switching transistor

FMMT4125

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Collector-Base Voltage	V_{CBO}	−30	V
Collector-Emitter Voltage	V_{CES}	−30	V
Emitter-Base Voltage	V_{EBO}	−4	V
Continuous Collector Current	I_C	−200	mA

CHARACTERISTICS (at 25°C ambient temperature unless otherwise stated).

Parameter	Symbol	Min.	Max.	Unit	Conditions
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	−30	—	V	$I_C = -1mA$*
Collector-base breakdown voltage	$V_{(BR)CBO}$	−30	—	V	$I_C = -10\mu A$
Emitter-base breakdown voltage	$V_{(BR)EBO}$	−4	—	V	$I_E = -10\mu A$
Collector-base cut-off current	I_{CBO}	—	−50	nA	$V_{CB} = -20V$
Emitter-base cut-off current	I_{EBO}	—	−50	nA	$V_{BE} = -3V$
Static forward current transfer ratio	h_{FE}	50 25	150 —		$I_C = -2mA$, $V_{CE} = -1V$* $I_C = -50mA$, $V_{CE} = -1V$*
Collector-emitter saturation voltage	$V_{CE(sat)}$	—	0.4	V	$I_C = -50mA$, $I_B = -5mA$*
Base-emitter saturation voltage	$V_{BE(sat)}$	—	0.95	V	$I_C = -50mA$, $I_B = -5mA$*
Transition frequency	f_T	200	—	MHz	$V_{CE} = -20V$, $I_C = -10mA$ $f = 100MHz$
Output capacitance	C_{obo}	—	4.5	pF	$V_{CB} = -5V$, $f = 140kHz$
Input capacitance	C_{ibo}	—	10	pF	$V_{EB} = -0.5V$, $f = 140kHz$
Small signal current transfer ratio	h_{fe}	50	200		$I_C = -2mA$, $V_{CE} = -1V$, $f = 1kHz$
Noise figure	N	—	5	dB	$I_C = -200\mu A$, $V_{CE} = -5V$ Rg $-2k\Omega$, $f = 30Hz$ to 15kHz at −3dB points

SWITCHING CHARACTERISTICS (at 25°C ambient temperature).

Parameter	Symbol	Typ.	Unit	Conditions
Delay time	t_d	25	ns	$V_{CC} = -3V$, $V_{BE(off)} = -0.5V$ $I_C = -10mA$, $I_{B1} = -1mA$
Rise time	t_r	18	ns	
Storage time	t_s	140	ns	$V_{CC} = -3V$, $I_C = -10mA$ $I_{B1} = I_{B2} = -1mA$
Fall time	t_f	15	ns	

*Measured under pulsed conditions. Pulse width = 300μs. Duty cycle ≤ 2%.

Devices are identified by a code on the body of the device

FMMT4125 . . . . . ZD

PNP silicon planar general purpose switching transistor

FMMT4126

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Collector-Base Voltage	V_{CBO}	−25	V
Collector-Emitter Voltage	V_{CEO}	−25	V
Emitter-Base Voltage	V_{EBO}	−4	V
Continuous Collector Current	I_C	−200	mA

CHARACTERISTICS (at $T_{amb} = 25°C$ unless otherwise stated).

Parameter	Symbol	Min.	Max.	Unit	Conditions
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	−25	—	V	$I_C = -1mA$*
Collector-base breakdown voltage	$V_{(BR)CBO}$	−25	—	V	$I_C = -10\mu A$
Emitter-base breakdown voltage	$V_{(BR)EBO}$	−4	—	V	$I_E = -10\mu A$
Collector-base cut-off current	I_{CBO}	—	−50	nA	$V_{CB} = -20V$
Emitter-base cut-off current	I_{EBO}	—	−50	nA	$V_{EB} = -3V$
Static forward current transfer ratio	h_{FE}	120 60	360 —		$I_C = -2mA$, $V_{CE} = -1V$* $I_C = -50mA$, $V_{CE} = -1V$*
Collector-emitter saturation voltage	$V_{CE(sat)}$	—	0.4	V	$I_C = -50mA$, $I_B = -5mA$*
Base-emitter saturation voltage	$V_{BE(sat)}$	—	0.95	V	$I_C = -50mA$, $I_B = -5mA$*
Transition frequency	f_T	250	—	MHz	$V_{CE} = -20V$, $I_C = -10mA$ $f = 100MHz$
Output capacitance	C_{obo}	—	4.5	pF	$V_{CB} = -5V$, $f = 140kHz$
Input capacitance	C_{ibo}	—	10	pF	$V_{EB} = -0.5V$, $f = 140kHz$
Small signal current transfer ratio	h_{fe}	120	480		$I_C = -2mA$, $V_{CE} = -1V$, $f = 1kHz$
Noise figure	N	—	4	dB	$I_C = -200\mu A$, $V_{CE} = -5V$ $R_g = -2k\Omega$, $f = 30Hz$ to $15kHz$ at $-3dB$ points

SWITCHING CHARACTERISTICS (at $T_{amb} = 25°C$).

Parameter	Symbol	Typ.	Unit	Conditions
Delay time	t_d	25	ns	$V_{CC} = -3V$, $V_{BE(off)} = -0.5V$ $I_C = -10mA$, $I_{B1} = -1mA$
Rise time	t_r	18	ns	
Storage time	t_s	140	ns	$V_{CC} = -3V$, $I_C = -10mA$ $I_{B1} = I_{B2} = -1mA$
Fall time	t_f	15	ns	

*Measured under pulsed conditions. Pulse width = 300μs. Duty cycle = ⩽2%.

Devices are identified by a code on the body of the device

FMMT4126 . . . . . ZE

NPN silicon planar general purpose switching transistors

FMMT4400
FMMT4401

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	FMMT4400	FMMT4401	Unit
Collector-Base Voltage	V_{CBO}	60	60	V
Collector-Emitter Voltage	V_{CEO}	40	40	V
Emitter-Base Voltage	V_{EBO}	6	6	V
Continuous Collector Current	I_C	600	600	mA

CHARACTERISTICS (at $T_{amb} = 25°C$ unless otherwise stated).

Parameter	Symbol	FMMT4400		FMMT4401		Unit	Conditions
		Min.	Max.	Min.	Max.		
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	40	—	40	—	V	$I_C = 1mA$ $I_B = 0$
Collector-base breakdown voltage	$V_{(BR)CBO}$	60	—	60	—	V	$I_C = 0.1mA$, $I_E = 0$
Emitter-base breakdown voltage	$V_{(BR)EBO}$	6	—	6	—	V	$I_E = 0.1mA$, $I_C = 0$
Collector-emitter cut-off current	I_{CEX}	—	0.1	—	0.1	μA	$V_{CE} = 35V$ $V_{EB(off)} = 0.4V$
Base cut-off current	I_{BEX}	—	0.1	—	0.1	μA	$V_{CE} = 35V$ $V_{EB(off)} = 0.4V$
Static forward current transfer ratio	h_{FE}	— 20 40 50 20	— — — 150 —	20 40 80 100 40	— — — 300 —		$I_C = 0.1mA$, $V_{CE} = 1V$ $I_C = 1mA$, $V_{CE} = 1V$ $I_C = 10mA$, $V_{CE} = 1V$ $I_C = 150mA$, $V_{CE} = 1V$* $I_C = 500mA$, $V_{CE} = 2V$*
Collector-emitter saturation voltage	$V_{CE(sat)}$	— —	0.4 0.75	— —	0.4 0.75	V V	$I_C = 150mA$, $I_B = 15mA$* $I_C = 500mA$, $I_B = 50mA$*
Base-emitter saturation voltage	$V_{BE(sat)}$	0.75 —	0.95 1.2	0.75 —	0.95 1.2	V V	$I_C = 150mA$, $I_B = 15mA$* $I_C = 500mA$, $I_B = 50mA$*
Transition frequency	f_T	200	—	250	—	MHz	$I_C = 20mA$, $V_{CE} = 10V$ $f = 100MHz$
Output capacitance	C_{obo}	—	6.5	—	6.5	pF	$V_{CB} = 5V$, $I_E = 0$ $f = 100kHz$
Input capacitance	C_{ibo}	—	30	—	30	pF	$V_{EB} = 0.5V$, $I_C = 0$ $f = 100kHz$

*Measured under pulsed conditions. Pulse width = 300μs. Duty cycle = 2%.

SWITCHING CHARACTERISTICS (at $T_{amb} = 25°C$).

Parameter	Symbol	Minimum	Maximum	Unit	Conditions
Turn-on time	t_{on}	—	35	ns	$V_{CC} = 30V$, $V_{EB(off)} = 2V$ $I_C = 150mA$, $I_{B1} = 15mA$ (See Fig. 1)
Turn-off time	t_{off}	—	255	ns	$V_{CC} = 30V$, $I_C = 150mA$ $I_{B1} = I_{B2} = 15mA$ (See Fig. 2)

CIRCUITS FOR MEASURING SWITCHING TIMES

TURN-ON TIME

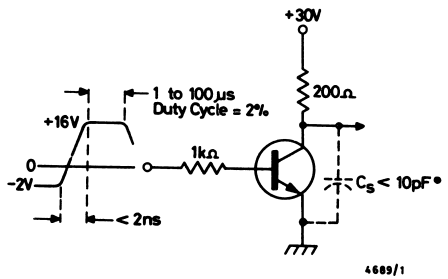


Fig. 1

TURN-OFF TIME

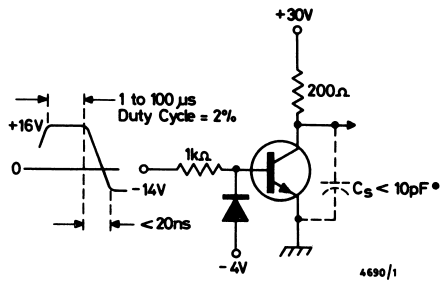


Fig. 2 Oscilloscope Rise Time $< 4ns$

● Total shunt capacitance of test jig, connectors and oscilloscope

Devices are identified by a code on the body of the device

FMMT4400	1K
FMMT4401	1L

PNP silicon planar general purpose switching transistors

FMMT4402
FMMT4403

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	FMMT4402	FMMT4403	Unit
Collector-Base Voltage	V_{CBO}	−40	−40	V
Collector-Emitter Voltage	V_{CEO}	−40	−40	V
Emitter-Base Voltage	V_{EBO}	−5	−5	V
Continuous Collector Current	I_C	−600	−600	mA

CHARACTERISTICS (at $T_{amb} = 25°C$ unless otherwise stated).

Parameter	Symbol	FMMT4402		FMMT4403		Unit	Conditions
		Min.	Max.	Min.	Max.		
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	−40	—	−40	—	V	$I_C = -1mA$, $I_B = 0$
Collector-base breakdown voltage	$V_{(BR)CBO}$	−40	—	−40	—	V	$I_C = -0.1mA$, $I_E = 0$
Emitter-base breakdown voltage	$V_{(BR)EBO}$	−5	—	−5	—	V	$I_E = -0.1mA$, $I_C = 0$
Collector-emitter cut-off current	I_{CEX}	—	−0.1	—	−0.1	μA	$V_{CE} = -35V$ $V_{EB(off)} = -0.4V$
Base cut-off current	I_{BEX}	—	−0.1	—	−0.1	μA	$V_{CE} = -35V$ $V_{EB(off)} = -0.4V$
Static forward current transfer ratio	h_{FE}	— 30 50 50 20	— — — 150 —	30 60 100 100 20	— — — 300 —		I_C −0.1 mA, $V_{CE} = -1V$ $I_C = -1mA$, $V_{CE} = -1V$ $I_C = -10mA$, $V_{CE} = -1V$ $I_C = -150mA$, $V_{CE} = -2V$* $I_C = -500mA$, $V_{CE} = -2V$*
Collector-emitter saturation voltage	$V_{CE(sat)}$	— —	−0.4 −0.75	— —	−0.4 −0.75	V V	$I_C = -150mA$, $I_B = -15mA$* $I_C = -500mA$, $I_B = -50mA$*
Base-emitter saturation voltage	$V_{BE(sat)}$	−0 75 —	−0.95 −1.3	−0.75 —	−0.95 −1.3	V V	$I_C = -150mA$, $I_B = -15mA$* $I_C = -500mA$, $I_B = -50mA$*
Transition frequency	f_T	150	—	200	—	MHz	$I_C = -50mA$, $V_{CE} = -20V$ $f = 100MHz$
Output capacitance	C_{obo}	—	8.5	—	8.5	pF	$V_{CB} = -10V$, $I_E = 0$ $f = 100kHz$
Input capacitance	C_{ibo}	—	30	—	30	pF	$I_C = 0$, $f = 100kHz$

*Measured under pulsed conditions. Pulse width = 200μs. Duty cycle = 1%.

SWITCHING CHARACTERISTICS (at $T_{amb} = 25°C$).

Parameter	Symbol	Minimum	Maximum	Unit	Conditions
Turn-on time	t_{on}	—	35	ns	$V_{CC} = -30V$, $V_{BE(off)} = -2V$ $I_C = -150mA$, $I_{B1} = -15mA$ (See Fig. 1)
Turn-off time	t_{off}	—	255	ns	$V_{CC} = -30V$, $I_C = -150mA$ $I_{B1} = I_{B2} = -15mA$ (See Fig. 2)

CIRCUITS FOR MEASURING SWITCHING TIMES

TURN-ON TIME

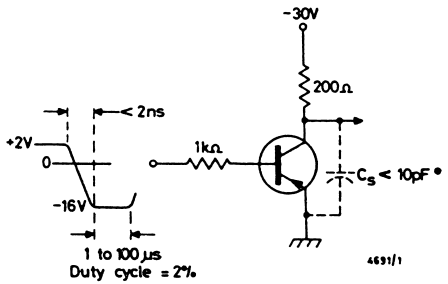


Fig. 1

TURN-OFF TIME

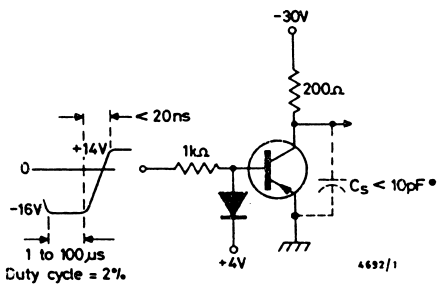


Fig. 2 Oscilloscope Rise Time $< 4ns$

● Total shunt capacitance of test jig, connectors and oscilloscope

Devices are identified by a code on the body of the device

FMMT4402	2K
FMMT4403	2L

PNP silicon planar small signal transistor

FMMT5087

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Collector-Base Voltage	V_{CBO}	−50	V
Collector-Emitter Voltage ($I_C = -2mA$)	V_{CEO}	−50	V
Emitter-Base Voltage	V_{EBO}	−3	V
Continuous Collector Current	I_C	−100	mA

CHARACTERISTICS (at $T_j = 25°C$ unless otherwise stated).

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Collector-base cut-off current	I_{CBO}	— —	— —	−10 −50	nA μA	$I_E = 0$, $V_{CB} = -10V$ $I_E = 0$, $V_{CB} = -35V$
Emitter-base cut-off current	I_{EBO}	—	—	−50	nA	$V_{EB} = -3V$, $I_C = 0$
Collector-emitter saturation voltage	$V_{CE(sat)}$	—	—	−300	mV	$I_C = -10mA$, $I_B = -1mA$
Base-emitter ON voltage	$V_{BE(on)}$	—	—	−850	mV	$I_C = -1mA$, $V_{CE} = -5V$
Static forward current transfer ratio	h_{FE}	250 250 250	— — —	800 — —		$I_C = -100\mu A$, $V_{CE} = -5V$ $I_C = -1mA$, $V_{CE} = -5V$ $I_C = -10mA$, $V_{CE} = -5V$*
Transition frequency	f_T	40	—	—	MHz	$I_C = -500\mu A$, $V_{CE} = -5V$ $f = 20MHz$
Small signal current transfer ratio	h_{fe}	250	—	900	MHz	$I_C = -1mA$, $V_{CE} = -5V$ $f = 1kHz$
Noise figure	N	—	—	2	dB	$I_C = -200\mu A$, $V_{CE} = -5V$ $R_g = 2k\Omega$ $f = 30Hz$ to $15kHz$ at 2dB points
Output capacitance	C_{obo}	—	—	4	pF	$V_{CB} = -5V$, $I_E = 0$ $f = 140kHz$

*Measured under pulsed conditions. Pulse width = 300μs, Duty cycle = 2%.

Devices are identified by a code on the body of the device

FMMT5087 . . . . . 2M
FMMT5087R 3M

NPN silicon planar small signal transistors

FMMT5088
FMMT5089

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	FMMT5088	FMMT5089	Unit
Collector Voltage	V_{CBO}	35	30	V
Collector-Emitter Voltage	V_{CEO}	30	25	V
Emitter-Base Voltage	V_{EBO}	4.5	4.5	V
Collector Current	I_C	50	50	mA

CHARACTERISTICS (at $T_{amb}=25°C$ unless otherwise stated).

Parameter	Symbol	FMMT5088		FMMT5089		Unit	Conditions
		Min.	Max.	Min.	Max.		
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	30	–	25	–	V	$I_C=1mA$, $I_B=0$
Collector-base breakdown voltage	$V_{(BR)CBO}$	35	–	30	–	V	$I_C=100\mu A$, $I_E=0$
Collector-base cut-off current	I_{CBO}	– –	50 –	– –	– 50	nA nA	$V_{CB}=20V$, $I_E=0$ $V_{CB}=15V$, $I_E=0$
Emitter-base cut-off current	I_{EBO}	– –	50 –	– –	– 100	nA nA	$V_{EB(off)}=3V$, $I_C=0$ $V_{EB(off)}=4.5V$, $I_C=0$
Collector-emitter saturation voltage	$V_{CE(sat)}$	–	0.5	–	0.5	V	$I_C=10mA$, $I_B=1mA$
Base-emitter saturation voltage	$V_{BE(sat)}$	–	0.8	–	0.8	V	$I_C=10mA$, $I_B=1mA$
Static forward current transfer ratio	h_{FE}	300	900	400	1200		$I_C=100\mu A$, $V_{CE}=5V$
		350	–	450	–		$I_C=1mA$, $V_{CE}=5V$
		300	–	400	–		$I_C=10mA$, $V_{CE}=5V$
Transition frequency	f_T	50	–	50	–	MHz	$I_C=500\mu A$, $V_{CE}=5V$ $f=20MHz$
Collector-base capacitance	C_{cbo}	–	4	–	4	pF	$V_{CB}=5V$, $f=1MHz$, $I_E=0$
Emitter-base capacitance	C_{ebo}	–	10	–	10	pF	$V_{BE}=0.5V$, $f=1MHz$ $I_C=0$
Noise figure	N	–	3	–	2	dB	$I_C=200\mu A$, $V_{CE}=5V$ $R_g=10k\Omega$, $f=10Hz$ to $15kHz$
Small signal current transfer ratio	h_{fe}	350	1400	450	1800		$I_C=1mA$, $V_{CE}=5V$ $f=1kHz$

Devices are identified by a code on the body of the device

FMMT5088 . . . . . 1Q
FMMT5089 . . . . . 1R

NPN silicon planar small signal transistors

FMMT5209
FMMT5210

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	FMMT5209	FMMT5210	Unit
Collector-base Voltage	V_{CBO}	50	50	V
Collector-Emitter Voltage ($I_C = 2mA$)	V_{CEO}	50	50	V
Emitter-Base Voltage	V_{EBO}	4.5	4.5	V
Collector Current	I_C	50	50	mA

CHARACTERISTICS (at $T_{amb} = 25°C$ unless otherwise specified).

Parameter	Symbol	FMMT5209		FMMT5210		Unit	Conditions
		Min.	Max.	Min.	Max.		
Collector-base cut-off current	I_{CBO}	—	50	—	50	nA	$V_{CB} = 35V$, $I_E = 0$
Emitter-base cut-off current	I_{EBO}	—	50	—	50	nA	$V_{EB} = 3V$, $I_C = 0$
Collector-emitter saturation voltage	$V_{CE(sat)}$	—	700	—	700	mV	$I_C = 10mA$, $I_B = 1mA$
Base-emitter ON voltage	$V_{BE(on)}$	—	850	—	850	mV	$I_C = 1mA$, $V_{CE} = 5V$
Static forward current transfer ratio	h_{FE}	100	300	200	600		$I_C = 100\mu A$, $V_{CE} = 5V$
		150	—	250	—		$I_C = 1mA$, $V_{CE} = 5V$
		150	—	250	—		$I_C = 10mA$, $V_{CE} = 5V$*
Transition frequency	f_T	30	—	30	—	MHz	$I_C = 500\mu A$, $V_{CE} = 5V$ $f = 20MHz$
Small signal current transfer ratio	h_{fe}	150	600	250	900	MHz	$I_C = 1mA$, $V_{CE} = 5V$ $f = 1kHz$
Noise figure	N	—	3	—	2	dB	$I_C = 200\mu A$, $V_{CE} = 5V$ $R_g = 2k\Omega$, $f = 30Hz$ to $15kHz$ at $-3dB$ points
		—	4	—	3	dB	$I_C = 200\mu A$, $V_{CE} = 5V$ $R_g = 2k\Omega$, $f = 1kHz$ $\triangle f = 200Hz$
Output capacitance	C_{obo}	—	4	—	4	pF	$V_{CB} = 5V$, $I_E = 0$ $f = 140kHz$

Devices are identified by a code on the body of the device

FMMT5209 . . . . . 2Q
FMMT5210 . . . . . 2R

PNP silicon high voltage transistors

FMMT 5400
FMMT 5401

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	FMMT 5400	FMMT 5401	Unit
Collector-Base Voltage	V_{CBO}	−130	−160	V
Collector-Emitter Voltage	V_{CEO}	−120	−150	V
Base-Emitter Voltage	V_{EBO}	−5	−5	V
Continuous Collector Current	I_C	−600	−600	mA

ELECTRICAL CHARACTERISTICS (at T_{amb} = 25°C unless otherwise stated)

Parameter	Symbol	FMMT 5400		FMMT 5401		Unit	Test Conditions
		Min.	Max.	Min.	Max.		
Collector-base breakdown voltage	$V_{(BR)CBO}$	−130	—	−160	—	V	I_C = −100μA
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	−120	—	−150	—	V	I_C = −1mA
Emitter-base breakdown voltage	$V_{(BR)EBO}$	−5	—	−5	—	V	I_E = −10μA
Collector cut-off current	I_{CBO}	— —	−100 −100			nA μA	V_{CB} = −100V V_{CB} = −100V, T_A = 100°C
				—	−50	nA	V_{CB} = −120V
				—	−50	μA	V_{CB} = −120V, T_A = 100°C
Static forward current transfer ratio	h_{FE}	30 40 40	— 180 —	50 60 50	— 240 —		I_C = −1mA, V_{CE} = −5V I_C = −10mA, V_{CE} = −5V I_C = −50mA, V_{CE} = −5V
Collector-emitter saturation voltage	$V_{CE(sat)}$	— —	−0.2 −0.5	— —	−0.2 −0.5	V V	I_C = −10mA, I_B = −1mA I_C = −50mA, I_B = −5mA
Base-emitter saturation voltage	$V_{BE(sat)}$	— —	−1.0 −1.0	— —	−1.0 −1.0	V V	I_C = −10mA, I_B = −1mA I_C = −50mA, I_B = −5mA
Transition frequency	f_T	100	400	100	300	MHz	I_C = −10mA, V_{CE} = −10V, f = 100MHz
Output capacitance	C_{obo}	—	6.0	—	6.0	pF	V_{CB} = −10V, f = 1MHz
Small signal current gain	h_{fe}	30	200	40	200		I_C = −1mA, V_{CE} = −10V, f = 1kHz
Noise figure	NF	—	8.0	—	8.0	dB	I_C = −250μA, V_{CE} = −5V, R_S = 1KΩ, f = 10Hz to 15.7kHz

Devices are identified by a code on the body of the device

FMMT 5400 . . . . . 1L
FMMT 5401 . . . . . 2L

NPN silicon high voltage transistors

FMMT 5550
FMMT 5551

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	FMMT 5550	FMMT 5551	Unit
Collector-Base Voltage	V_{CBO}	160	180	V
Collector-Emitter Voltage	V_{CEO}	140	160	V
Base-Emitter Voltage	V_{EBO}	6	6	V
Continuous Collector Current	I_C	600	600	mA

ELECTRICAL CHARACTERISTICS (at $T_{amb} = 25°C$ unless otherwise stated)

Parameter	Symbol	FMMT 5550		FMMT 5551		Unit	Test Conditions
		Min.	Max.	Min.	Max.		
Collector-base breakdown voltage	$V_{(BR)CBO}$	160	—	180	—		$I_C = 100\mu A$
Collector-emitter breakdown voltage	$V_{(BR)EBO}$	140	—	160	—	V	$I_C = 1mA$
Emitter-base breakdown voltage	$V_{(BR)EBO}$	6	—	6	—	V	$I_C = 10mA$
Collector cut-off current	I_{CBO}	— —	100 100	— —	— 50 50	nA μA nA μA	$V_{CB} = 100V$ $V_{CB} = 100V$, $T_A = 100°C$ $V_{CB} = 120V$ $V_{CB} = 120V$, $T_A = 100°C$
Static forward current transfer ratio	h_{FE}	60 60 20	— 250 —	80 80 30	— 250 —		$I_C = 1mA$, $V_{CE} = 5V$ $I_C = 10mA$, $V_{CE} = 5V$ $I_C = 50mA$, $V_{CE} = 5V$
Collector-emitter saturation voltage	$V_{CE(sat)}$	— —	0.15 0.25	— —	0.15 0.20	V V	$I_C = 10mA$, $I_B = 1mA$ $I_C = 50mA$, $I_B = 5mA$
Base-emitter saturation voltage	$V_{BE(sat)}$	— —	1.0 1.2	— —	1.0 1.2	V V	$I_C = 10mA$, $I_B = 1mA$ $I_C = 50mA$, $I_B = 5mA$
Transition frequency	f_T	100	300	100	300	MHz	$I_C = 10mA$, $V_{CE} = 10V$ $f = 100MHz$
Output capacitance	C_{obo}	—	6.0	—	6.0	pF	$V_{CB} = 10V$, $f = 1MHz$
Small signal current gain	h_{fe}	50	200	50	200		$I_C = 1mA$, $V_{CE} = 10V$ $f = 1kHz$
Noise figure	NF	—	10	—	8	dB	$I_C = 250\mu A$, $V_{CE} = 5V$ $R_S = 1K\Omega$ $f = 10Hz$ to $15.7kHz$

Devices are identified by a code on the body of the device

FMMT 5550 . . . . . IF

FMMT 5551 . . . . . GI

Silicon variable capacitance diode

FMMV105G

ELECTRICAL CHARACTERISTICS (at $T_{amb}=25°C$ unless otherwise specified)

Characteristic	Symbol	Value			Units	Conditions
		Min.	Typ.	Max.		
Reverse breakdown voltage	V_{BR}	30	—	—	V	$I_R=10\mu A$
Reverse leakage current	I_R	—	—	0.05	μA	$V_R=28V$
Series inductance	L_S	—	3.0	—	nH	f=250MHz
Diode capacitance temperature coefficient	T_{CC}	—	280	—	ppm/°C	$V_R=3V$, f=1MHz

TUNING CHARACTERISTICS (at $T_{amb}=25°C$ ambient temperature).

Characteristic	Symbol	Value			Units	Conditions
		Min.	Typ.	Max.		
Diode capacitance	C_d	1.8	—	2.8	pF	$V_R=25V$, f-1MHz
Capacitance ratio	C_d/C_d	4.0	—	6.0	—	3V/25V, f=1 MHz
Figure of MERIT	Q	250	350	—	—	$V_R=3V$, f=50MHz

PIN CONFIGURATION

Devices are identified by a code on the body of the device

FMMV105G 4E

Silicon variable capacitance diode

FMMV109

ELECTRICAL CHARACTERISTICS (at $T_{amb}=25°C$ unless otherwise specified)

Characteristic	Symbol	Value			Units	Conditions
		Min.	Typ.	Max.		
Reverse breakdown voltage	V_{BR}	30	—	—	V	$I_R=10\mu A$
Reverse leakage current	I_R	—	—	0.02	μA	$V_R=25V$
Series inductance	L_S	—	3.0	—	nH	f=250MHz
Diode capacitance temperature coefficient	T_{CC}	—	280	—	ppm/°C	$V_R=3V$, f=1MHz
Case capacitance	C_C	—	0.1	—	pF	f=1MHz

TUNING CHARACTERISTICS (at $T_{amb}=25°C$ ambient temperature).

Characteristic	Symbol	Value			Units	Conditions
		Min.	Typ.	Max.		
Diode capacitance	C_d	26	—	32	pF	$V_R=3V$, f-1MHz
Capacitance ratio	C_d/C_d	5.0	—	6.5	—	3V/25V, f=1 MHz
Figure of MERIT	Q	200	250	—	—	$V_R=3V$, f=50MHz

PIN CONFIGURATION

Devices are identified by a code on the body of the device

FMMV109 . . . . . 4A

Silicon variable capacitance diodes

FMMV2101-FMMV2109

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Reverse voltage	V_R	30	V
Forward current	I_F	20	mA

CHARACTERISTICS (at $T_{amb}=25°C$).

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test conditions
Reverse breakdown voltage	$V_{(BR)R}$	30	—	—	V	$I_R=10\mu A$
Reverse leakage current	I_R	—	—	20	nA	$V_R=25V$
Inductance	L_S	—	3.0	—	nH	f=250MHz lead length ≈ 1.5mm
Capacitance	C_C	—	0.15	—	pF	f=1MHz lead length ≈ 1.5mm
Temperature coefficient of capacitance	TC_C	—	280	400	ppm/°C	$V_R=4V$, f=1MHz

TUNING CHARACTERISTICS (at $T_{amb}=25°C$).

Type No.	Nominal capacitance (pF) ($V_R=4V$, f=1MHz)			Figure of merit minimum Q ($V_R=4V$ f=50MHz)	Tuning ratio, C_2/C_{30} (f=1MHz)	
	Min.	Nom.	Max.		Min.	Max.
FMMV2101	6.1	6.8	7.5	450	2.5	3.3
FMMV2102	7.3	8.2	9	450	2.6	3.3
FMMV2103	9	10	11	400	2.6	3.3
FMMV2104	10.8	12	13.2	400	2.6	3.3
FMMV2105	13.5	15	16.5	400	2.6	3.3
FMMV2106	16.2	18	19.8	350	2.7	3.3
FMMV2107	19.8	22	24.2	350	2.7	3.3
FMMV2108	24.3	27	29.7	300	2.7	3.3
FMMV2109	29.7	33	36.3	280	2.7	3.3

PIN CONFIGURATION

FMMV2102/06/86

Devices are identified by a code on the body of the device

FMMV2101	6R
FMMV2102	6F
FMMV2103	6G
FMMV2104	6H
FMMV2105	6J
FMMV2106	6K
FMMV2107	6L
FMMV2108	6M
FMMV2109	6N

Silicon variable capacitance diode

FMMV3102

ELECTRICAL CHARACTERISTICS (at $T_{amb}=25°C$ unless otherwise specified)

Characteristic	Symbol	Value			Units	Conditions
		Min.	Typ.	Max.		
Reverse breakdown voltage	V_{BR}	30	—	—	V	$I_R=10\mu A$
Reverse leakage current	I_R	—	—	0.1	μA	$V_R=25V$
Series inductance	L_S	—	3.0	L_S	nH	f=250MHz
Diode capacitance temperature coefficient	T_{CC}	—	280	—	ppm/°C	$V_R=3V$, f=1MHz
Case capacitance	C_C	—	0.1	C_C	pF	f=1MHz

TUNING CHARACTERISTICS (at $T_{amb}=25°C$ ambient temperature).

Characteristic	Symbol	Value			Units	Conditions
		Min.	Typ.	Max.		
Diode capacitance	C_d	20	—	25	pF	$V_R=3V$, f-1MHz
Capacitance ratio	C_d/C_d	4.5	—	—	—	3V/25V, f=1 MHz
Figure of MERIT	Q	200	300	—	—	$V_R=3V$, f=50MHz

PIN CONFIGURATION

Devices are identified by a code on the body of the device

FMMV3102 . . . . . 4C

Silicon voltage regulator diodes

FMMZ5232-FMMZ5257

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Voltage range	V_Z	5.6 to 33	V
Nominal tolerance	C*	±5	%
Forward current	I_F	250	mA

*As per Pro-Electron coding system.

ELECTRICAL CHARACTERISTICS (at T_{amb} = 25°C).

Type No.	Nominal Zener Voltage V_Z@I_{ZT}	Test Current I_{ZT}	Max. Zener impedance		Max. reverse leakage current			Max. Zener voltage temperature coefficient
			Z_{ZT}@I_{ZT}	Z_{ZT}@I_{ZK} = 0.25mA	I_R	@	V_R V	
	V	mA	Ω	Ω	μA	A	B	V_Z(%/°C)
FMMZ5232	5.6	20	11	1600	5	2.9	3	+0.038
FMMZ5233	6	20	7	1600	5	3.3	3.5	+0.038
FMMZ5234	6.2	20	7	1000	5	3.8	4	+0.045
FMMZ5235	6.8	20	5	750	3	4.8	5	+0.050
FMMZ5236	7.5	20	6	500	3	5.7	6	+0.058
FMMZ5237	8.2	20	8	500	3	6.2	6.5	+0.062
FMMZ5238	8.7	20	8	600	3	6.2	6.5	+0.065
FMMZ5239	9.1	20	10	600	3	6.7	7	+0.068
FMMZ5240	10	20	17	600	3	7.6	8	+0.075
FMMZ5241	11	20	22	600	2	8	8.4	+0.076
FMMZ5242	12	20	30	600	1	8.7	9.1	+0.077
FMMZ5243	13	9.5	13	600	0.5	9.4	9.9	+0.079
FMMZ5244	14	9	15	600	0.1	9.5	10	+0.082
FMMZ5245	15	8.5	16	600	0.1	10.5	11	+0.082
FMMZ5246	16	7.8	17	600	0.1	11.4	12	+0.083
FMMZ5247	17	7.4	19	600	0.1	12.4	13	+0.084
FMMZ5248	18	7	21	600	0.1	13.3	14	+0.085
FMMZ5249	19	6.6	23	600	0.1	13.3	14	+0.086
FMMZ5250	20	6.2	25	600	0.1	14.3	15	+0.086
FMMZ5251	22	5.6	29	600	0.1	16.2	17	+0.087
FMMZ5252	24	5.2	33	600	0.1	17.1	18	+0.088
FMMZ5253	25	5	35	600	0.1	18.1	19	+0.089
FMMZ5254	27	4.6	41	600	0.1	20	21	+0.090
FMMZ5255	28	4.5	44	600	0.1	20	21	+0.091
FMMZ5256	30	4.2	49	600	0.1	22	23	+0.091
FMMZ5257	33	3.8	58	700	0.1	24	25	+0.092

V_F = 1.1V max. @ I_F = 200mA for all types

PIN CONFIGURATION

FMMZ5232/06/86

Devices are identified by a code on the body of the device

FMMZ5232	8G
FMMZ5233	8H
FMMZ5234	8J
FMMZ5235	8K
FMMZ5236	8L
FMMZ5237	8M
FMMZ5238	8N
FMMZ5239	8P
FMMZ5240	8Q
FMMZ5241	8R
FMMZ5242	8S
FMMZ5243	8T
FMMZ5244	8U
FMMZ5245	8V
FMMZ5246	8W
FMMZ5247	8X
FMMZ5248	8Y
FMMZ5249	8Z
FMMZ5250	81A
FMMZ5251	81B
FMMZ5252	81C
FMMZ5253	81D
FMMZ5254	81E
FMMZ5255	81F
FMMZ5256	81G
FMMZ5257	81H

High speed switching diodes

HD2A
HD3A
HD4A

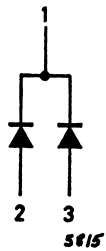
ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	HD2A/3A/4A	Unit
Continuous reverse voltage	V_R	75	V
Forward current	I_F	100	mA

CHARACTERISTICS (at $T_j = 25°C$ unless otherwise stated).

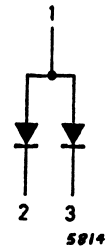
Parameter	Symbol	Min.	Max.	Unit	Test Conditions
Breakdown voltage	V_{BR}	85	—	V	$I_R = 100\mu A$
Forward voltage	V_F	0.5 —	0.715 1.0	V V	$I_F = 1mA$ $I_F = 10mA$
Reverse current	I_R	— —	1.0 60	μA μA	$V_R = 75V$ $V_R = 75V$, $T_j = 125°C$
Total capacitance	C_T	—	4	pF	$V_R = 0$, $f = 1MHz$
Reverse recovery time	t_{rr}	Typ 6		ns	$I_F = 10mA$, $I_R = 10mA$ $I_{rr} = 1mA$,

PIN CONFIGURATIONS



HD2A
(Common Cathode)

HD3A
(Single Diode)



HD4A
(Common Anode)

Devices are identified by a code on the body of the device

HD2A	5D
HD3A	4D
HD4A	7D

NPN silicon planar high voltage transistor

HT2

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Collector-Base Voltage	V_{CBO}	90	V
Collector-Emitter Voltage	V_{CEO}	80	V
Emitter-Base Voltage	V_{EBO}	5	V
Collector Current	I_C	100	mA

CHARACTERISTICS (at 25°C ambient temperature unless otherwise stated).

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Collector-base breakdown voltage	$V_{(BR)CBO}$	90	—	—	V	$I_C = 10\mu A$,
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	80	—	—	V	$I_C = 2mA$
Emitter-base breakdown voltage	$V_{(BR)EBO}$	5	—	—	V	$I_E = 10\mu A$
Collector cut-off currents	I_{CBO}	—	—	100	nA	$V_{CB} = 80V$, $I_E = 0$
	I_{CES}	— —	— —	100 5	nA μA	$V_{CE} = 80V$, $V_{BE} = 0$ $V_{CE} = 80V$, $V_{BE} = 0$ $T_j = 125°C$
	I_{CEX}	—	—	10	μA	$V_{CE} = 80V$, $V_{BE} = 0.2V$ $T_j = 85°C$
	I_{EBO}	—	—	200	nA	$V_{EB} = 4V$
Static forward current transfer ratio	h_{fe}	25 30 50 30	— — — —	— — — —		$I_C = 100\mu A$, $V_{CE} = 1V$ $I_C = 1mA$, $V_{CE} = 1V$ $I_C = 10mA$, $V_{CE} = 1V$ $I_C = 50mA$, $V_{CE} = 1V$
Collector-emitter saturation voltage	$V_{CE(sat)}$	—	—	750	mV	$I_C = 50mA$, $I_B = 5mA$
Base-emitter saturation voltage	$V_{BE(sat)}$	—	—	1.1	V	$I_C = 50mA$, $I_B = 5mA$
Output capacitance	C_{obo}	—	—	10	pF	$V_{CB} = 10V$, $I_E = 0$ $f = 1MHz$
Transition frequency	f_T	60	—	—	MHz	$V_{CE} = 5V$, $I_C = 10mA$ $f = 10MHz$
Switching times	t_{on} t_{off}	— —	— —	500 2000	ns ns	$I_C = 10mA$ $I_{B1} = I_{B2} = 1mA$

Devices are identified by a code on the body of the device

HT2 . . . . . 2T

PNP silicon planar high voltage transistor

HT3

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Collector-Base Voltage	V_{CBO}	−90	V
Collector-Emitter Voltage	V_{CEO}	−80	V
Emitter-Base Voltage	V_{EBO}	−5	V
Collector Current	I_C	100	mA

CHARACTERISTICS (at 25°C ambient temperature unless otherwise stated).

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Collector-base breakdown voltage	$V_{(BR)CBO}$	−90	—	—	V	$I_C = -10\mu A$
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	−80	—	—	V	$I_C = -2mA$
Emitter-base breakdown voltage	$V_{(BR)EBO}$	−5	—	—	V	$I_E = -10\mu A$
Collector cut-off currents	I_{CBO}	—	—	−100	nA	$V_{CB} = -80V$, $I_E = 0$
	I_{CES}	— —	— —	−100 −5	nA μA	$V_{CE} = -80V$, $V_{BE} = 0$ $V_{CE} = -80V$, $V_{BE} = 0$ $T_j = 125°C$
	I_{CEX}	—	—	−10	μA	$V_{CE} = -80V$ $V_{BE} = -0.2V$, $T_j = 85°C$
	I_{EBO}	—	—	−200	nA	$V_{BE} = -4V$
Static forward current transfer ratio	h_{FE}	30 35 50 30	— — — —	— — — —		$I_C = -100\mu A$, $V_{CE} = -1V$ $I_C = -1mA$, $V_{CE} = -1V$ $I_C = -10mA$, $V_{CE} = -1V$ $I_C = -50mA$, $V_{CE} = -1V$
Collector-emitter saturation voltage	$V_{CE(sat)}$	—	—	−750	mV	$I_C = -50mA$, $I_B = -5mA$
Base-emitter saturation voltage	$V_{BE(sat)}$	—	—	−1.1	V	$I_C = -50mA$, $I_B = -5mA$
Output capacitance	C_{obo}	—	—	10	pF	$V_{CB} = -10V$, $I_E = 0$ $f = 1MHz$
Transition frequency	f_T	50	—	—	MHz	$V_{CE} = -5V$, $I_C = -10mA$ $f = 10MHz$
Switching times	t_{on} t_{off}	— —	— —	500 1000	ns ns	$I_C = -10mA$ $I_{B1} = I_{B2} = -1mA$

Devices are identified by a code on the body of the device

HT3 . . . . . 3T

N-channel enhancement mode vertical DMOS FET

VN10LF

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	SOT-23	Unit
Drain-source voltage	V_{DS}	60	V
Continuous drain current (at $T_A = 25°C$)	I_D	0.15	A
Pulse drain current	I_{DM}	3	A
Gate-source voltage	V_{GS}	±20	V

CHARACTERISTICS (at T=25°C unless otherwise stated).

Parameter	Symbol	Min.	Max.	Unit	Conditions
Drain-source breakdown voltage	BV_{DSS}	60	—	V	$I_D = 100\mu A$, $V_{GS} = 0V$
Gate-source threshold voltage	$V_{GS(th)}$	0.8	2.5	V	$I_D = 1\,mA$, $V_{DS} = V_{GS}$
Gate body leakage	I_{GSS}	—	100	nA	$V_{GS} = \pm 20V$, $V_{DS} = 0V$
Zero gate voltage drain current	I_{DSS}	—	10	μA	V_{DS} = Max. rating, $V_{GS} = 0V$
On-state drain current (1)	$I_{D(on)}$	750	—	mA	$V_{DS} = 15V$, $V_{GS} = 10V$
Static drain-source on-state resistance (1)	$R_{DS(on)}$	—	5	Ω	$I_D = 500\,mA$, $V_{GS} = 10V$
		—	7.5	Ω	$I_D = 200\,mA$, $V_{GS} = 5V$
Forward transconductance (1) (2)	g_{fs}	100	—	mS	$V_{DS} = 15V$, $I_D = 500\,mA$
Input capacitance (2)	C_{iss}	—	60	pF	$V_{DS} = 25V$, $V_{GS} = 0V$, f = 1 MHz
Common source output capacitance (2)	C_{oss}	—	25	pF	
Reverse transfer capacitance (2)	C_{rss}	—	5	pF	
Turn-on time (2) (3)	$t_{(on)}$	—	10	ns	$V_{DD} = 15V$, $I_D = 0.6A$
Turn-off time (2) (3)	t_{off}	—	10	ns	

(1) Measured under pulsed conditions. Width=300μs, Duty cycle ≤ 2%.
(2) Sample test.
(3) Switching times measured with 50Ω source impedance and < 5ns rise time on a pulse generator.

Devices are identified by a code on the body of the device

VN10LF . . . . . MY

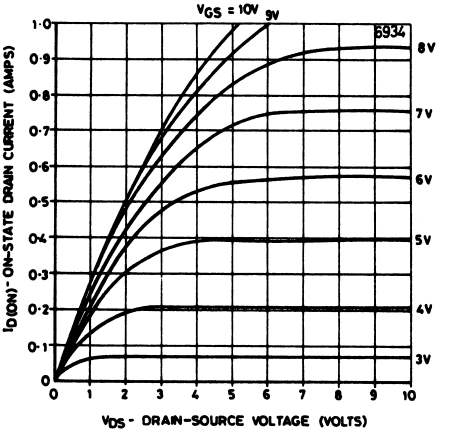


Fig 1. Typical saturation characteristics

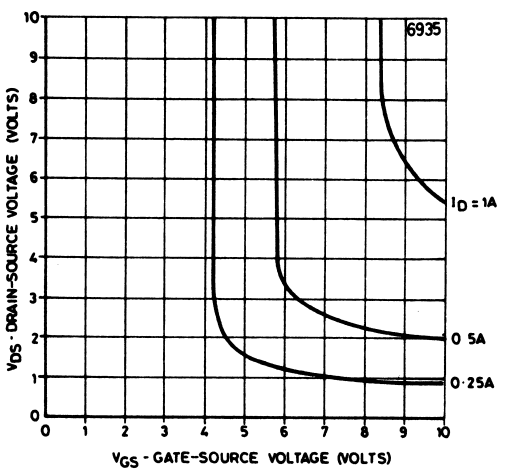


Fig 2. Typical voltage saturation characteristics

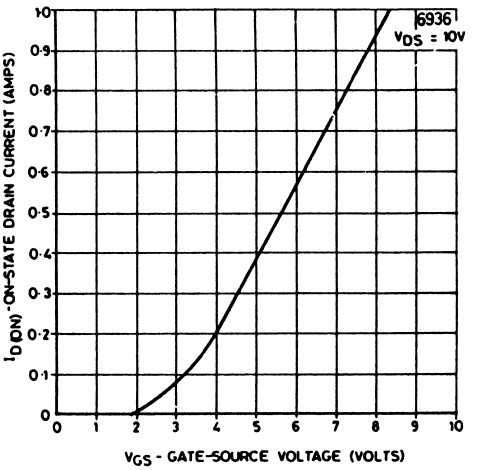


Fig 3. Typical transfer characteristics

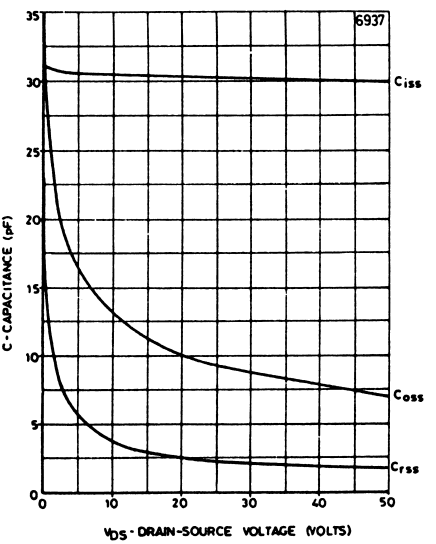


Fig 4. Typical capacitance v drain-source voltage

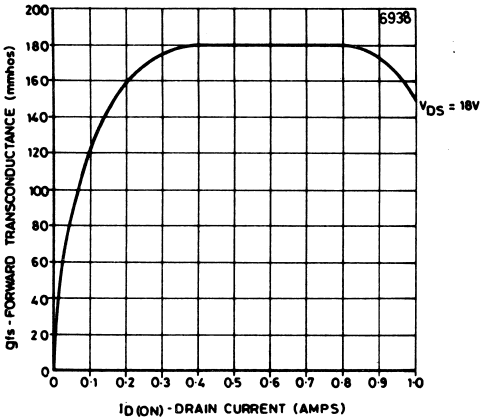


Fig 5. Typical transconductance v drain current

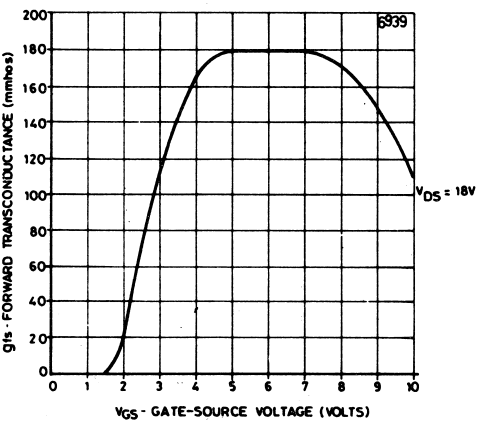


Fig 6. Typical transconductance v gate-source voltage

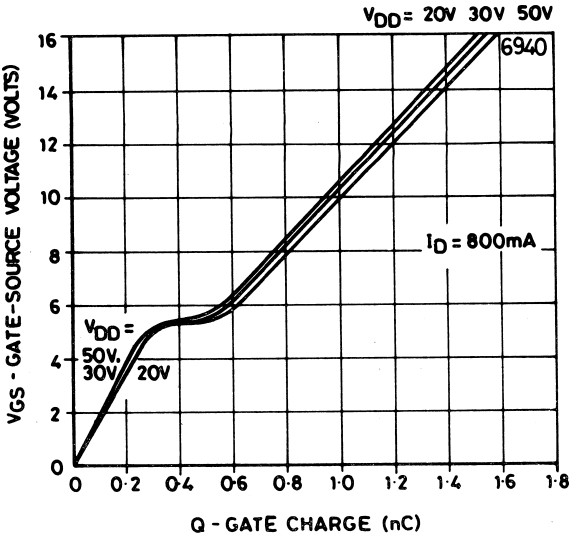


Fig 7. Typical gate charge v gate-source voltage

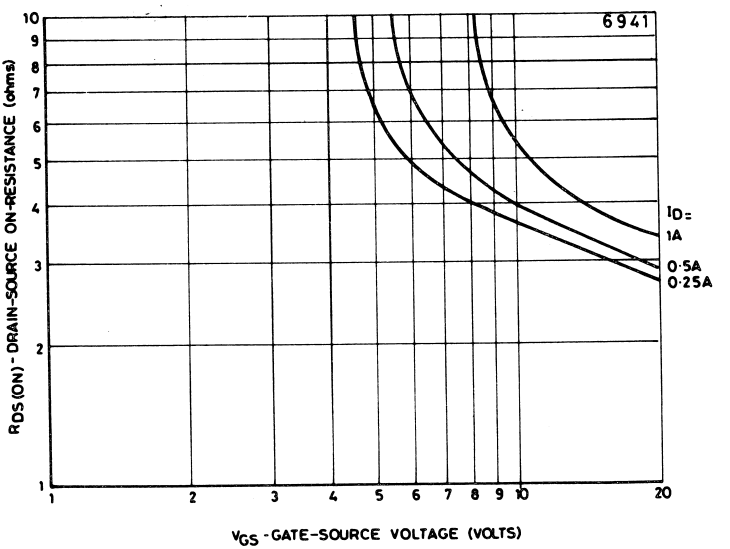


Fig 8. Typical on-resistance v gate-source voltage

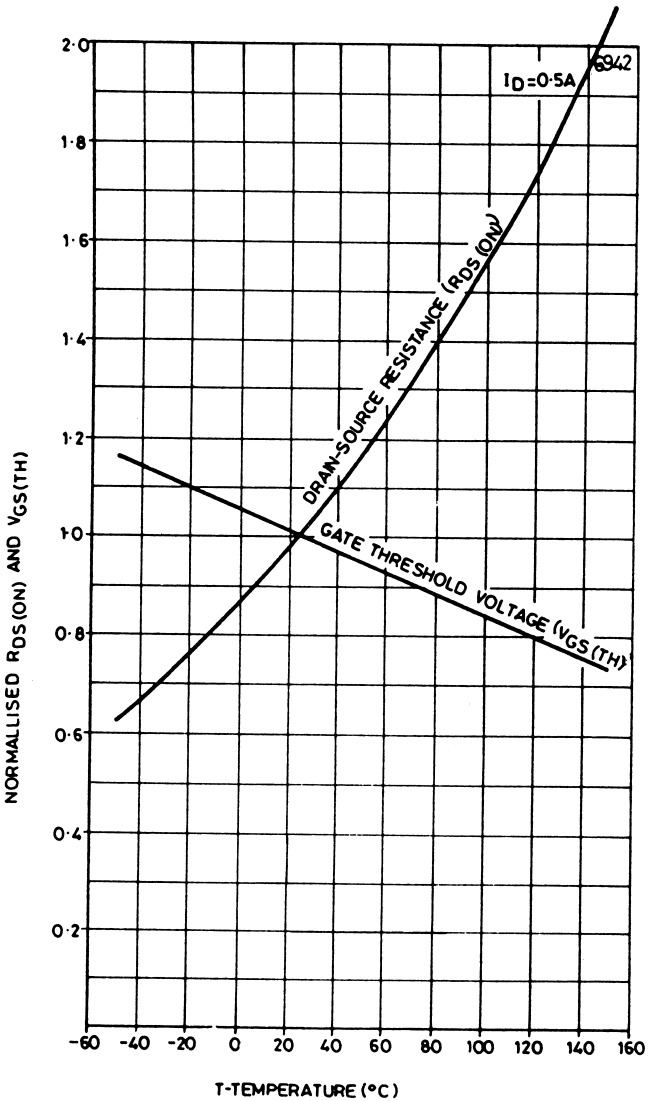


Fig 9. Normalised $R_{DS(on)}$ and $V_{GS(th)}$ v temperature

Silicon variable capacitance diodes

ZC830A ZC836A SERIES

ELECTRICAL CHARACTERISTICS (at 25°C ambient temperature).

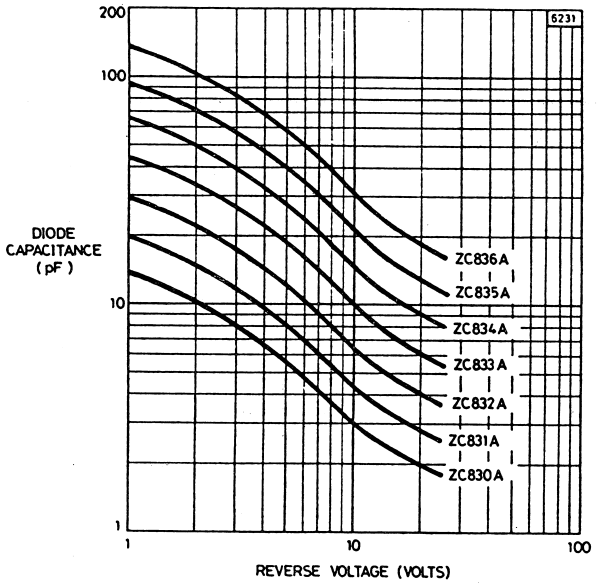
Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Reverse breakdown voltage	V_{BR}	25	—	—	V	$I_R = 10\mu A$
Reverse leakage current	I_R	—	—	0.02	μA	$V_R = 20V$
Temperature coefficient of capacitance	η	—	0.03	0.04	% per °C	$V_R = 3V$ f=1MHz

TUNING CHARACTERISTICS (at 25°C ambient temperature).

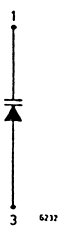
Type No.	Nominal capacitance (pF) ($V_R = 2V$, f=1MHz)			Figure of Merit Minimum Q ($V_R = 3V$ f=50MHz)	Tuning ratio, C_2/C_{20} (f=1MHz)	
	Min.	Nom.	Max.		Min.	Max.
ZC830A	9.0	10	11.0	300	4.5	6.0
ZC831A	13.5	15	16.5	300	4.5	6.0
ZC832A	19.8	22	24.2	200	5.0	6.5
ZC833A	29.7	33	36.3	200	5.0	6.5
ZC834A	42.3	47	51.7	200	5.0	6.5
ZC835A	61.2	68	74.8	100	5.0	6.5
ZC836A	90.0	100	110.0	100	5.0	6.5

Devices are also available with 5% and 20% tolerances.
No suffix — ±20% (e.g. ZC830). Suffix B — ±5% (e.g. ZC830B).

DIODE CAPACITANCE



PIN CONFIGURATION



Devices are identified by a code on the body of the device

ZC830,A,B	J1
ZC831,A,B	J3
ZC832,A,B	J4
ZC833,A,B	J2
ZC834,A,B	J5
ZC835,A,B	J6
ZC836,A,B	J7

Schottky barrier diodes

ZC2800E
ZC2810E
ZC2811E
ZC5800E

The ZC2810E is not recommended for NEW DESIGNS.

CHARACTERISTICS (at 25°C ambient temperature).

Parameter	Type	Symbol	Min.	Max.	Unit	Test Conditions
Breakdown Voltage	ZC2800E ZC2810E ZC2811E ZC5800E	V_{BR}	70 20 15 50	— — — —	V V V V	I_R=10μA
Reverse leakage current	ZC2800E ZC2810E ZC2811E ZC5800E	I_R	— — — —	200 100 100 200	nA nA nA nA	V_R=50V V_R=15V V_R=10V V_R=35V
Forward voltage	ZC2800E ZC2810E ZC2811E ZC5800E	V_F	— — — —	410 410 410 410	mV mV mV mV	I_F=1mA
Forward current	ZC2800E ZC2810E ZC2811E ZC5800E	I_F	15 35 20 15	— — — —	mA mA mA mA	V_F=1V
Capacitance	ZC2800E ZC2810E ZC2811E ZC5800E	C_T	— — — —	2.0 1.2 1.2 2.0	pF pF pF pF	V_R=0V f=1MHz
Effective minority lifetime	ZC2800E ZC2810E ZC2811E ZC5800E	τ	— — — —	100 100 100 100	ps ps ps ps	See test diagram

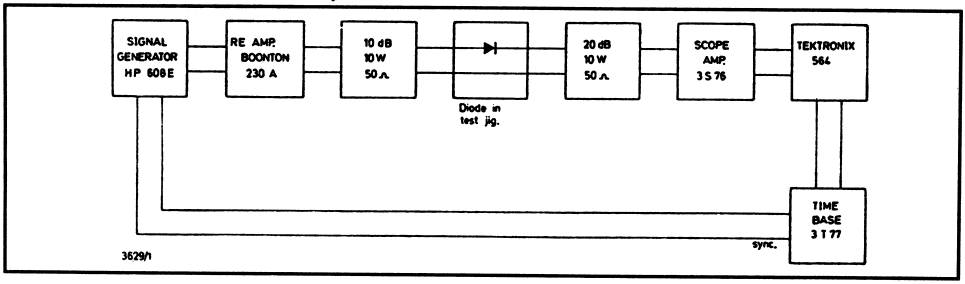
Note: Matched pairs or quads of diodes can be supplied on request.

STANDARD MATCHING SPECIFICATIONS:

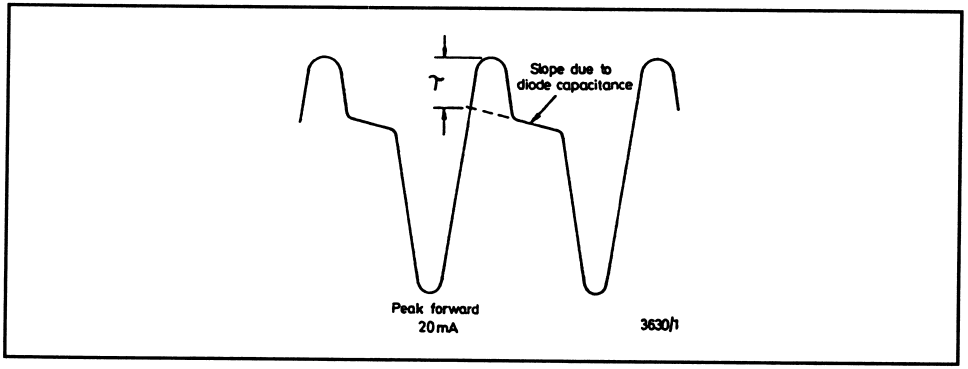
ZC2800E, ZC5800E
Max. $\triangle V$=20mV, I_F=0.5 to 5.0mA
Max. $\triangle C$=0.2pF, V_R=0V

ZC2810E, ZC2811E
Max. $\triangle V$=20mV, I_F=1 to 10mA
Max. $\triangle C$=0.2pF, V_R=0V

EFFECTIVE CARRIER LIFETIME (τ) TEST

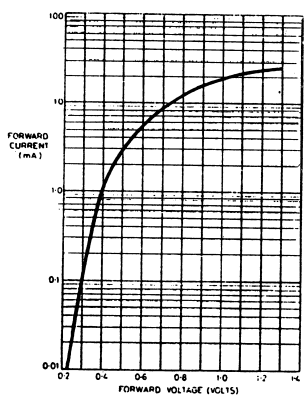


The signal generator is set to 54 MHz and the sampling scope is set to 20 mV/cm. The R.F. amplifier output is adjusted to give 5 cm. peak forward deflection, corresponding to a peak forward current through the diode of 20 mA. Under these conditions the waveform appearing on the oscilloscope will be as shown below.

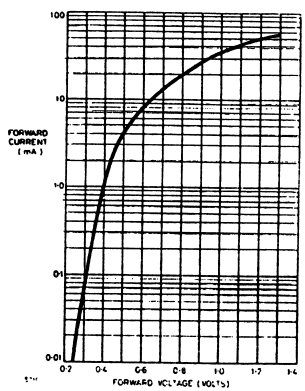


The amplitude τ is directly related to effective minority lifetime, with 1 cm. of amplitude corresponding to 500 ps lifetime.

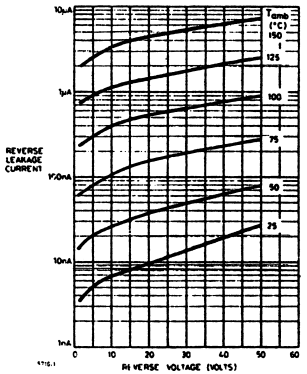
TYPICAL CHARACTERISTICS



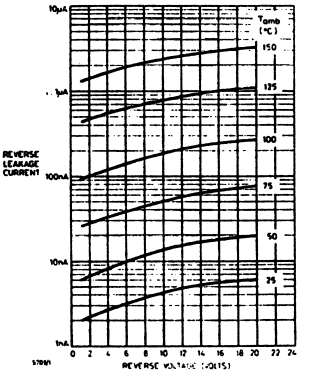
ZC2800E & ZC5800E



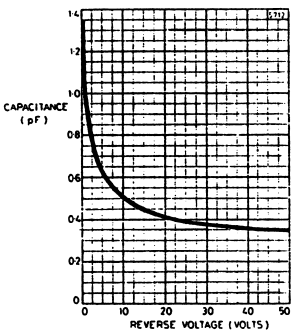
ZC2810E & ZC2811E



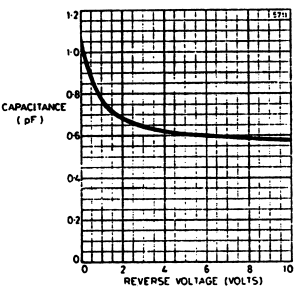
ZC2800E & ZC5800E



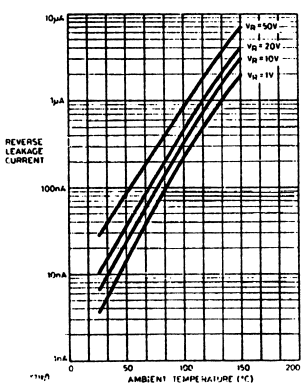
ZC2810E & ZC2811E



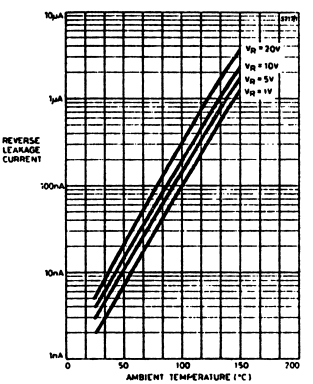
ZC2800E & ZC5800E



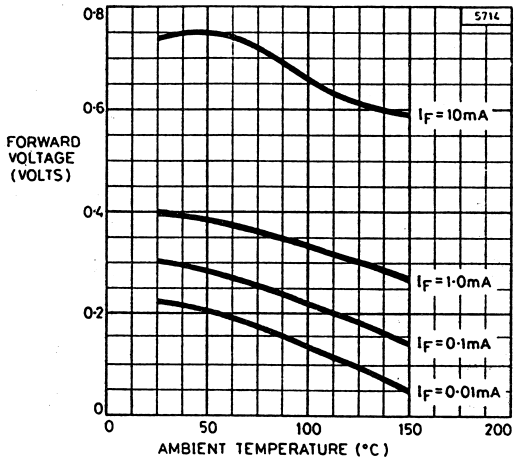
ZC2810E & ZC2811E



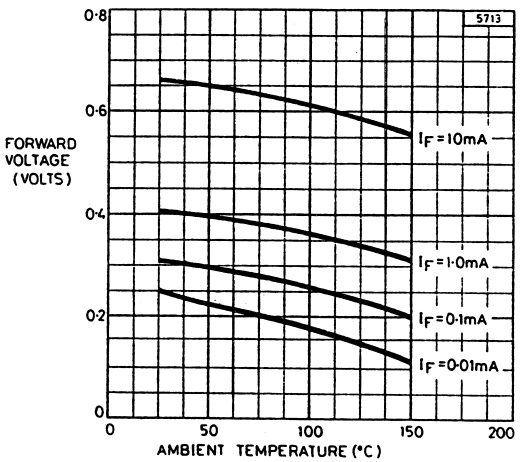
ZC2800E & ZC5800E



ZC2810E & ZC2811E



ZC2800E & ZC5800E



ZC2810E & ZC2811E

Pin configuration

Devices are identified by a code on the body of the device

ZC2800E	E6
ZC2810E	E7
ZC2811E	E8
ZC5800E	E9

N-channel enhancement mode vertical DMOS FET

ZVN3306F

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	SOT-23	Unit
Drain-source voltage	V_{DS}	60	V
Continuous drain current (at $T_A=25°C$)	I_D	0.15	A
Pulse drain current	I_{DM}	3	A
Gate-source voltage	V_{GS}	±20	V

ELECTRICAL CHARACTERISTICS (at T=25°C unless otherwise stated).

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Drain-source breakdown voltage	BV_{DSS}	60	—	—	V	$I_D=1mA$, $V_{GS}=0V$
Gate-source threshold voltage	$V_{GS(th)}$	0.8	—	2.4	V	$I_D=1mA$, $V_{DS}=V_{GS}$
Gate body leakage	I_{GSS}	—	—	20	nA	$V_{GS}=\pm 20V$, $V_{DS}=0V$
Zero gate voltage drain current	I_{DSS}	—	—	0.5	μA	V_{DS}=Max. rating, $V_{GS}=0V$
		—	—	50	μA	$V_{DS}=0.8\times$Max. rating, $V_{GS}=0V$ (T=125°C) (2)
On-state drain current (1)	$I_{D(on)}$	750	—	—	mA	$V_{DS}=18V$, $V_{GS}=10V$
Static drain-source on-state resistance (1)	$R_{DS(on)}$	—	—	5	Ω	$I_D=500mA$, $V_{GS}=10V$
Forward transconductance (1) (2)	g_{fs}	150	—	—	mS	$V_{DS}=18V$, $I_D=500mA$
Input capacitance (2)	C_{iss}	—	—	35	pF	$V_{DS}=18V$, $V_{GS}=0V$, f=1 MHz
Common source output capacitance (2)	C_{oss}	—	—	25	pF	
Reverse transfer capacitance (2)	C_{rss}	—	—	8	pF	
Turn-on delay time (2) (3)	$t_{d(on)}$	—	3	5	ns	$V_{DD}\approx 18V$, $I_D=500mA$
Rise time (2) (3)	t_r	—	4	7	ns	
Turn-off delay time (2) (3)	$t_{d(off)}$	—	4	6	ns	
Fall time (2) (3)	t_f	—	5	8	ns	

(1) Measured under pulsed conditions. Width=300μs, Duty cycle ≤ 2%.
(2) Sample test.
(3) Switching times measured with 50Ω source impedance and < 5ns rise time on a pulse generator.

SOURCE-DRAIN DIODE CHARACTERISTICS.

Parameter	Symbol	Typ.	Unit	Conditions
Diode forward voltage (1)	V_{SD}	0.85	V	V_{GS}=0V, I_S=270mA
Reverse recovery time	t_{rr}	90	ns	V_{GS}=0V, I_F=270mA I_R=100mA

(1) Measured under pulsed conditions. Width=300μs, Duty cycle$\leqslant$2%.

Devices are identified by a code on the body of the device

ZVN3306F . . . . . MC

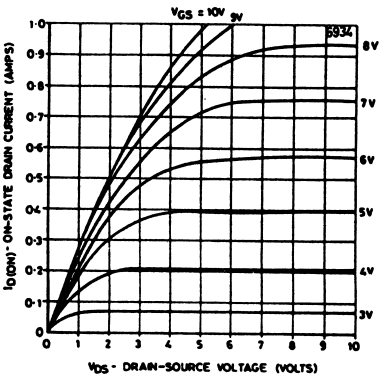


Fig 1. Typical saturation characteristics

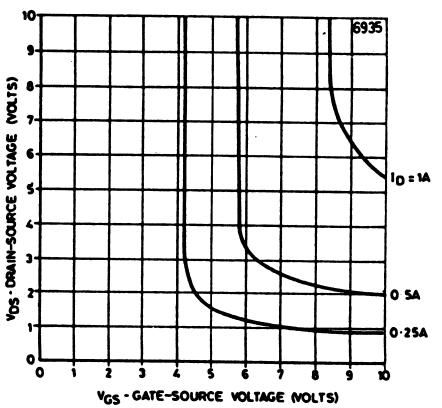


Fig 2. Typical voltage saturation characteristics

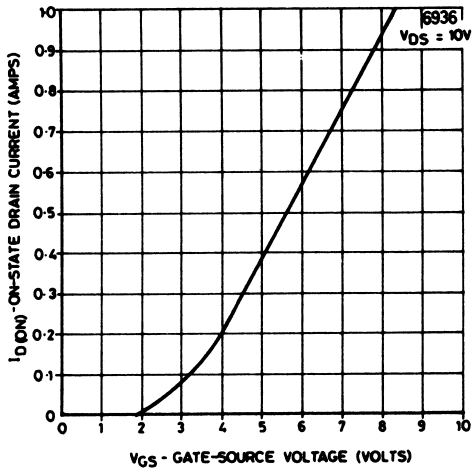


Fig 3. Typical transfer characteristics

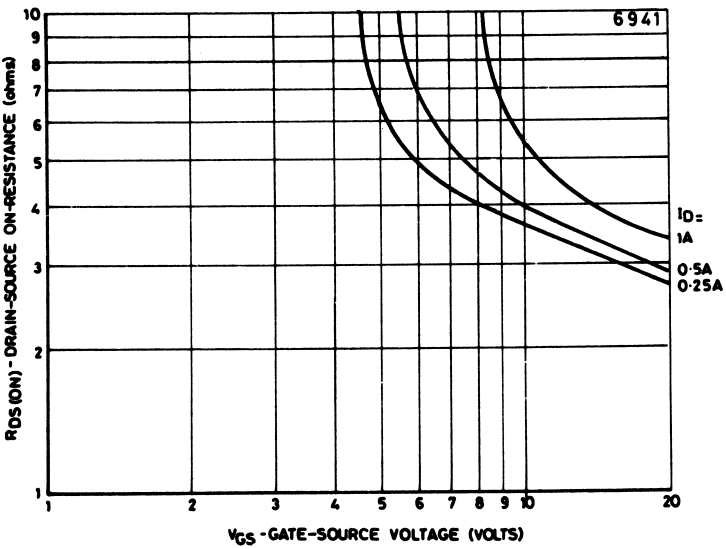


Fig 4. Typical capacitance v gate-source voltage

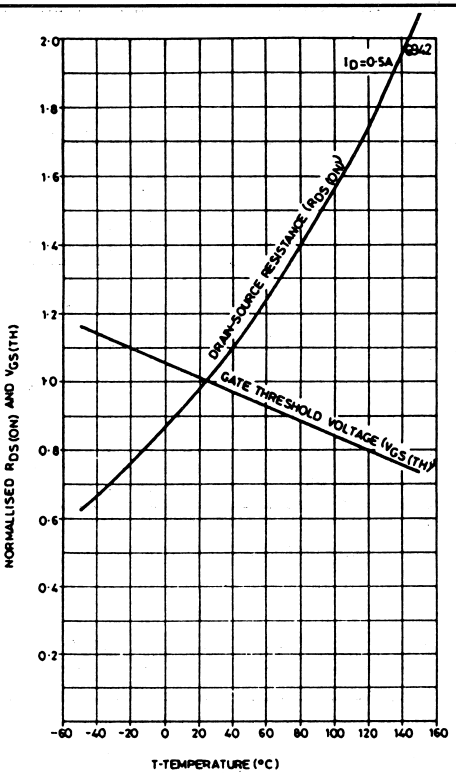


Fig 5. Normalised $R_{DS(on)}$ and $V_{GS(th)}$ v temperature

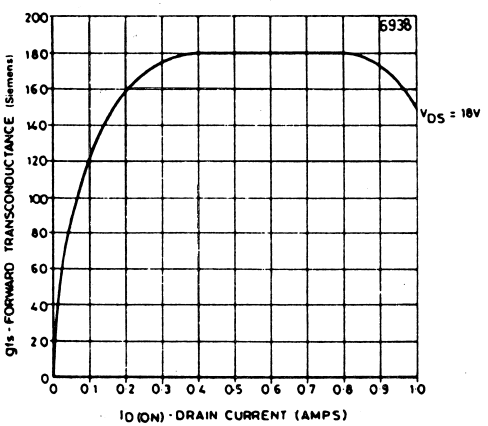


Fig 6. Typical transconductance v drain current

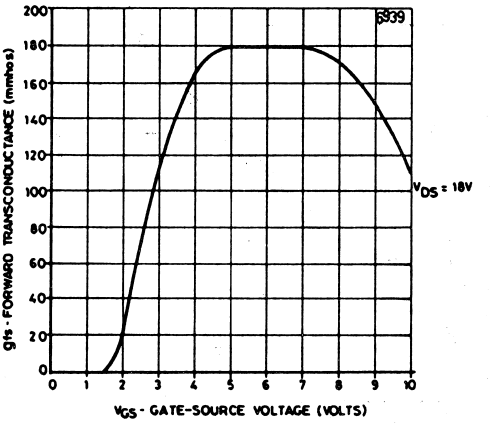


Fig 7. Typical transconductance v gate-source voltage

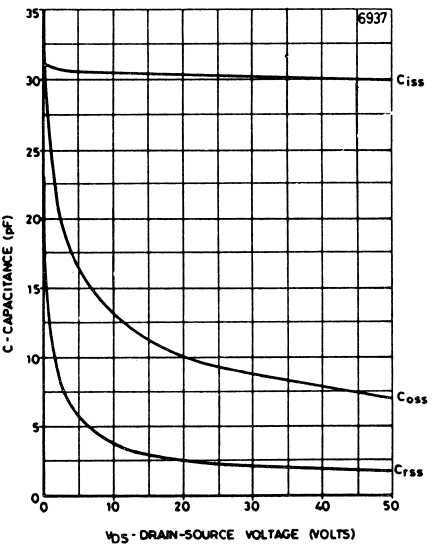


Fig 8. Typical capacitance v drain-source voltage

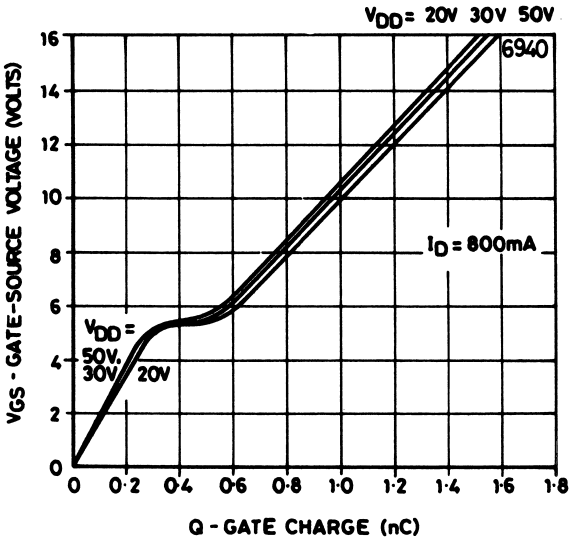


Fig. 9 Typical gate charge v gate-source voltage

N-channel enhancement mode vertical DMOS FET

ZVN3310F

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	SOT-23	Unit
Drain-source voltage	V_{DS}	100	V
Continuous drain current (at $T_A = 25°C$)	I_D	0.1	A
Pulse drain current	I_{DM}	2	A
Gate-source voltage	V_{GS}	±20	V

ELECTRICAL CHARACTERISTICS (at T=25°C unless otherwise stated).

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Drain-source breakdown voltage	BV_{DSS}	100	—	—	V	$I_D = 1mA$, $V_{GS} = 0V$
Gate-source threshold voltage	$V_{GS(th)}$	0.8	—	2.4	V	$I_D = 1mA$, $V_{DS} = V_{GS}$
Gate body leakage	I_{GSS}	—	—	20	nA	$V_{GS} = \pm 20V$, $V_{DS} = 0V$
Zero gate voltage drain current	I_{DSS}	—	—	1	μA	V_{DS} = Max. rating, $V_{GS} = 0V$
		—	—	50	μA	$V_{DS} = 0.8 \times$ Max. rating, $V_{GS} = 0V$ (T=125°C) (2)
On-state drain current (1)	$I_{D(on)}$	500	—	—	mA	$V_{DS} = 25V$, $V_{GS} = 10V$
Static drain-source on-state resistance (1)	$R_{DS(on)}$	—	—	10	Ω	$I_D = 500mA$, $V_{GS} = 10V$
Forward transconductance (1) (2)	g_{fs}	100	—	—	mS	$V_{DS} = 25V$, $I_D = 500mA$
Input capacitance (2)	C_{iss}	—	—	40	pF	$V_{DS} = 25V$, $V_{GS} = 0V$, f=1 MHz
Common source output capacitance (2)	C_{oss}	—	—	15	pF	
Reverse transfer capacitance (2)	C_{rss}	—	—	5	pF	
Turn-on delay time (2) (3)	$t_{d(on)}$	—	3	5	ns	$V_{DD} \approx 25V$, $I_D = 500mA$
Rise time (2) (3)	t_r	—	5	7	ns	
Turn-off delay time (2) (3)	$t_{d(off)}$	—	4	6	ns	
Fall time (2) (3)	t_f	—	5	7	ns	

(1) Measured under pulsed conditions. Width=300μs, Duty cycle ≤ 2%.
(2) Sample test.
(3) Switching times measured with 50Ω source impedance and < 5ns rise time on a pulse generator.

SOURCE-DRAIN DIODE CHARACTERISTICS.

Parameter	Symbol	Typ.	Unit	Conditions
Diode forward voltage (1)	V_{SD}	0.82	V	$V_{GS}=0V$, $I_S=200mA$

(1) Measured under pulsed conditions. Width=300μs, Duty cycle$\leqslant$2%.

Devices are identified by a code on the body of the device

ZVN3310F . . . . . MF

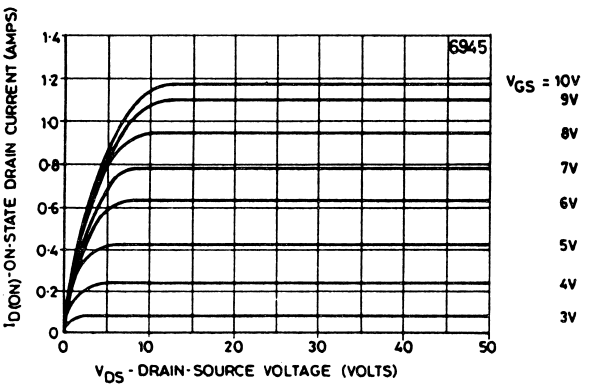


Fig. 1 Typical output characteristics

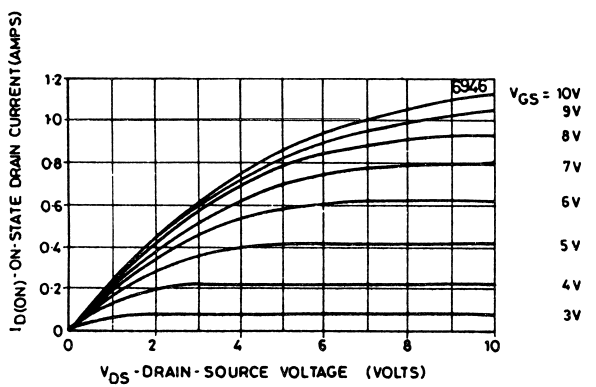


Fig. 2 Typical saturation characteristics

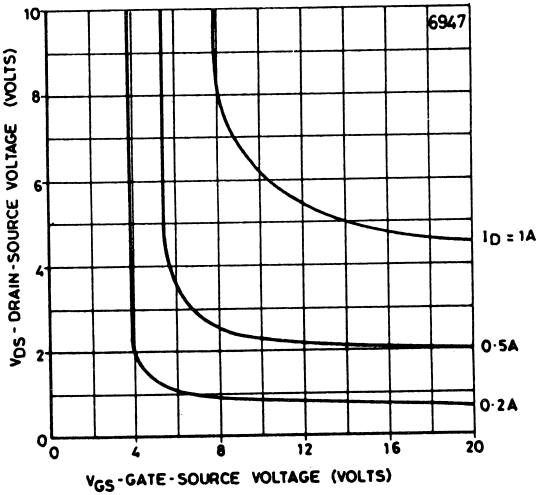


Fig 3. Typical voltage saturation characteristics

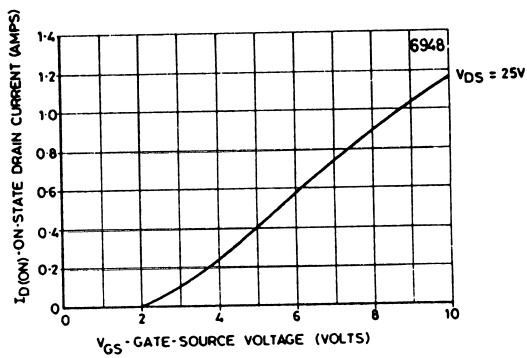


Fig 4. Typical transfer characteristics

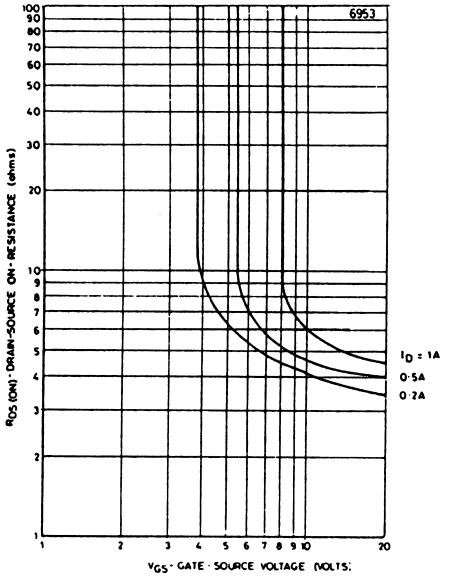


Fig. 5 Typical on-resistance v gate-source voltage

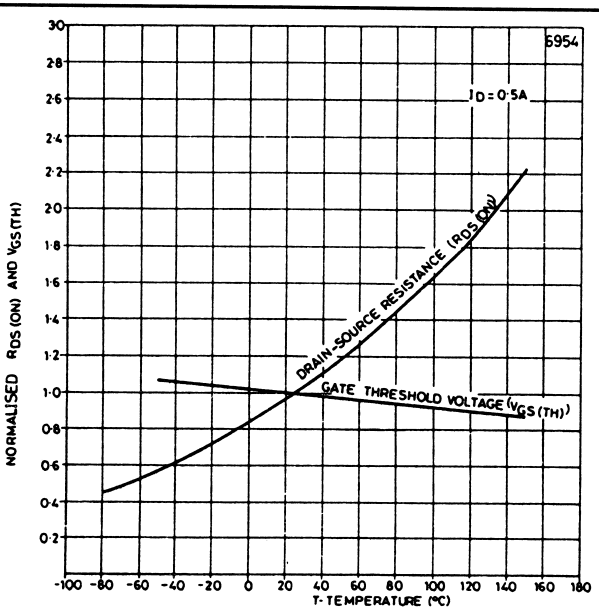


Fig 6. Normalised $R_{DS(on)}$ and $V_{GS(th)}$ v temperature

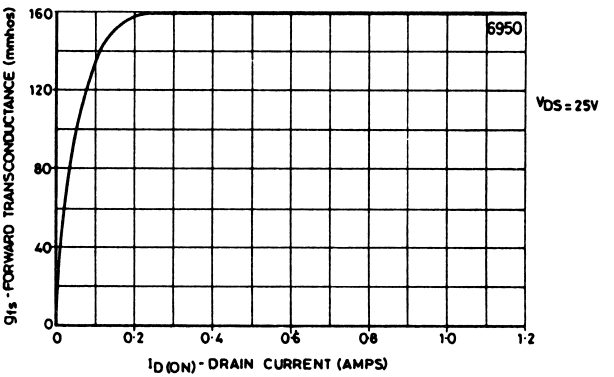


Fig 7. Typical transconductance v drain current

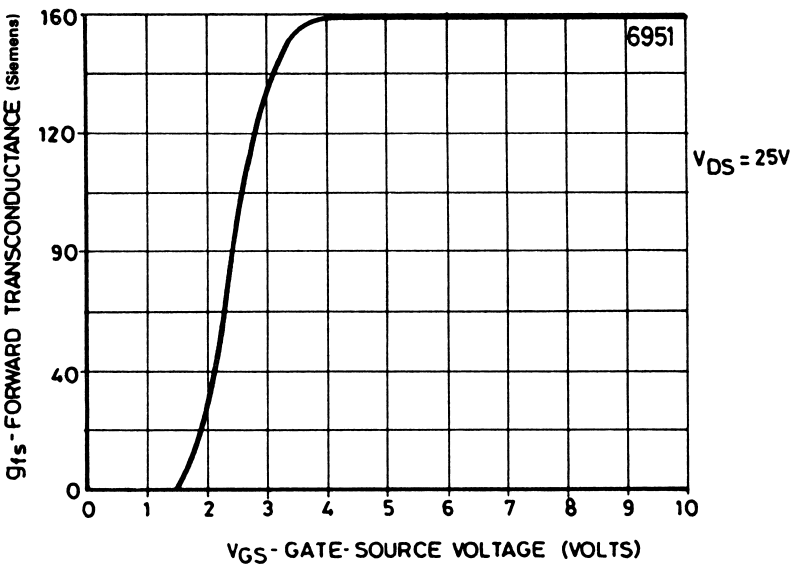


Fig 8. Typical transconductance v gate-source voltage

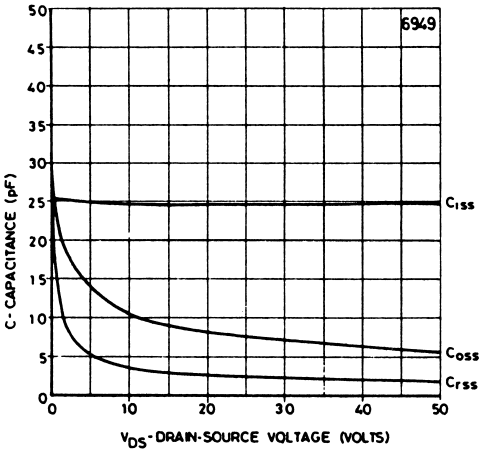


Fig. 9 Typical capacitance v drain-source voltage

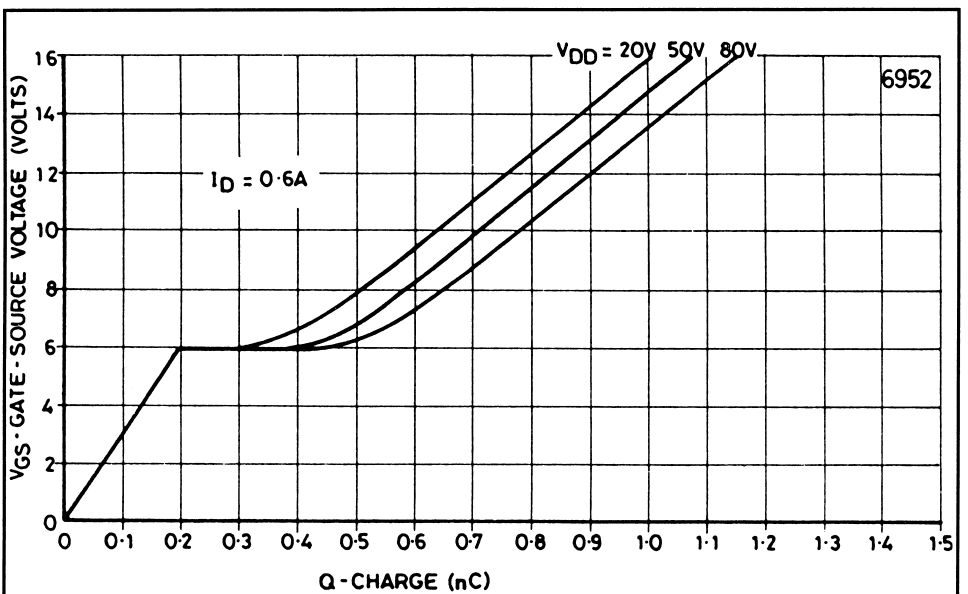


Fig. 10 Typical gate charge v gate-source voltage

N-channel enhancement mode vertical DMOS FET

ZVN3320F

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	SOT-23	Unit
Drain-source voltage	V_{DS}	200	V
Continuous drain current (at $T_A = 25°C$)	I_D	0.06	A
Pulse drain current	I_{DM}	1	A
Gate-source voltage	V_{GS}	±20	V

ELECTRICAL CHARACTERISTICS (at T=25°C unless otherwise stated).

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Drain-source breakdown voltage	BV_{DSS}	200	—	—	V	$I_D = 1mA$, $V_{GS} = 0V$
Gate-source threshold voltage	$V_{GS(th)}$	1	—	3	V	$I_D = 1mA$, $V_{DS} = V_{GS}$
Gate body leakage	I_{GSS}	—	0.1	100	nA	$V_{GS} = \pm 20V$, $V_{DS} = 0V$
Zero gate voltage drain current	I_{DSS}	—	—	10	μA	V_{DS} = Max. rating, $V_{GS} = 0V$
		—	—	50	μA	$V_{DS} = 0.8 \times$ Max. rating, $V_{GS} = 0V$ (T=125°C) (2)
On-state drain current (1)	$I_{D(on)}$	250	—	—	mA	$V_{DS} = 25V$, $V_{GS} = 10V$
Static drain-source on-state resistance (1)	$R_{DS(on)}$	—	—	25	Ω	$I_D = 100mA$, $V_{GS} = 10V$
Forward transconductance (1) (2)	g_{fs}	75	—	—	mS	$V_{DS} = 25V$, $I_D = 100mA$
Input capacitance (2)	C_{iss}	—	—	45	pF	$V_{DS} = 25V$, $V_{GS} = 0V$, f=1 MHz
Common source output capacitance (2)	C_{oss}	—	—	18	pF	
Reverse transfer capacitance (2)	C_{rss}	—	—	5	pF	
Turn-on delay time (2) (3)	$t_{d(on)}$	—	—	5	ns	$V_{DD} = 25V$, $I_D = 100mA$
Rise time (2) (3)	t_r	—	—	7	ns	
Turn-off delay time (2) (3)	$t_{d(off)}$	—	—	6	ns	
Fall time (2) (3)	t_f	—		6	ns	

(1) Measured under pulsed conditions. Width=300μs, Duty cycle ≤ 2%.
(2) Sample test.
(3) Switching times measured with 50Ω source impedance and < 5ns rise time on a pulse generator.

Devices are identified by a code on the body of the device

ZVN3320F . . . . . MU

N-channel enhancement mode vertical DMOS FET

ZVN4106F

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	SOT-23	Unit
Drain-source voltage	V_{DS}	60	V
Continuous drain current (at $T_A = 25°C$)	I_D	0.2	A
Pulse drain current	I_{DM}	3	A
Gate-source voltage	V_{GS}	±20	V

ELECTRICAL CHARACTERISTICS (at T=25°C unless otherwise stated).

Parameter	Symbol	Min.	Max.	Unit	Conditions
Drain-source breakdown voltage	BV_{DSS}	60	—	V	$I_D = 1\,mA$, $V_{GS} = 0V$
Gate-source threshold voltage	$V_{GS(th)}$	1.3	3	V	$I_D = 1\,mA$, $V_{DS} = V_{GS}$
Gate body leakage	I_{GSS}	—	100	nA	$V_{GS} = \pm 20V$, $V_{DS} = 0V$
Zero gate voltage drain current	I_{DSS}	—	10	μA	V_{DS} = Max. rating, $V_{GS} = 0V$
		—	50	μA	$V_{DS} = 0.8 \times$ Max. rating, $V_{GS} = 0V$ (T=125°C) (2)
On-state drain current (1)	$I_{D(on)}$	1	—	A	$V_{DS} = 25V$, $V_{GS} = 10V$
Static drain-source on-state resistance (1)	$R_{DS(on)}$	—	2.5	Ω	$I_D = 500\,mA$, $V_{GS} = 10V$
		—	5	Ω	$I_D = 200\,mA$, $V_{GS} = 5V$
Forward transconductance (1) (2)	g_{fs}	150	—	mS	$V_{DS} = 25V$, $I_D = 500\,mA$
Input capacitance (2)	C_{iss}	—	35	pF	$V_{DS} = 25V$, $V_{GS} = 0V$, f=1 MHz
Common source output capacitance (2)	C_{oss}	—	25	pF	
Reverse transfer capacitance (2)	C_{rss}	—	8	pF	
Turn-on delay time (2) (3)	$t_{d(on)}$	—	5	ns	$V_{DD} = 25V$, $I_D = 500\,mA$
Rise time (2) (3)	t_r	—	7	ns	
Turn-off delay time (2) (3)	$t_{d(off)}$	—	6	ns	
Fall time (2) (3)	t_f	—	8	ns	

(1) Measured under pulsed conditions. Width=300μs, Duty cycle ⩽ 2%.
(2) Sample test.
(3) Switching times measured with 50Ω source impedance and < 5ns rise time on a pulse generator.

Devices are identified by a code on the body of the device
ZVN4106F . . . . . MZ

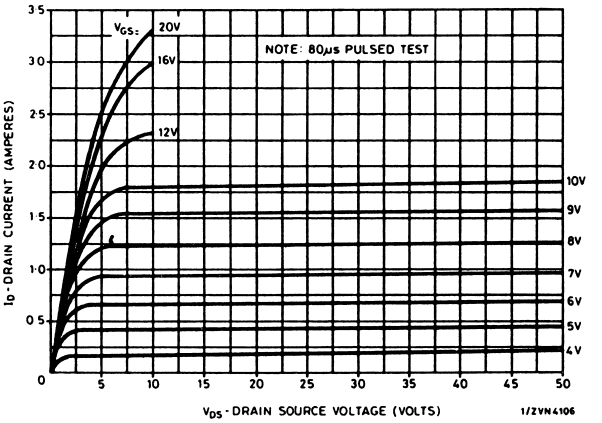


Fig 1. Typical output characteristics

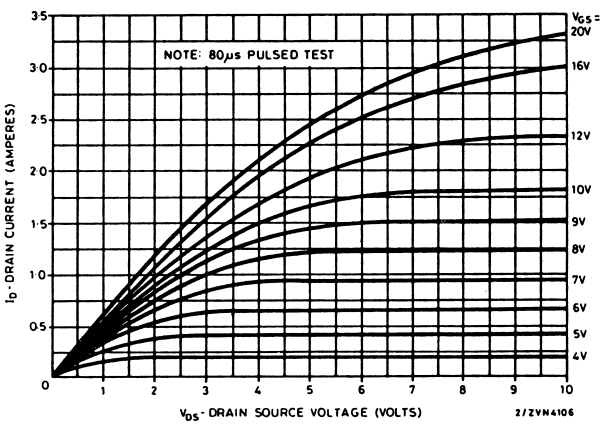


Fig 2. Typical saturation characteristics

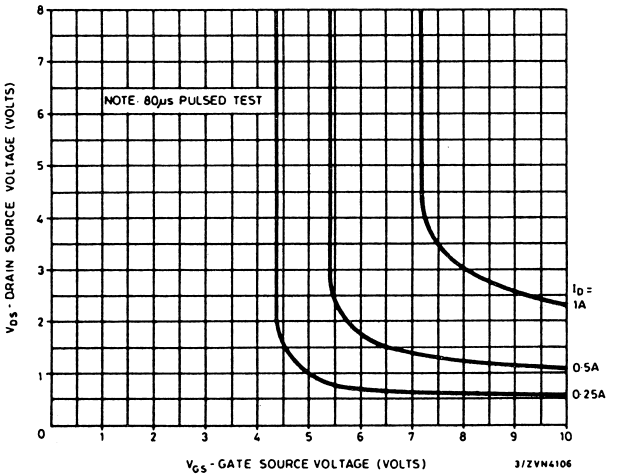


Fig 3. Typical voltage saturation characteristics

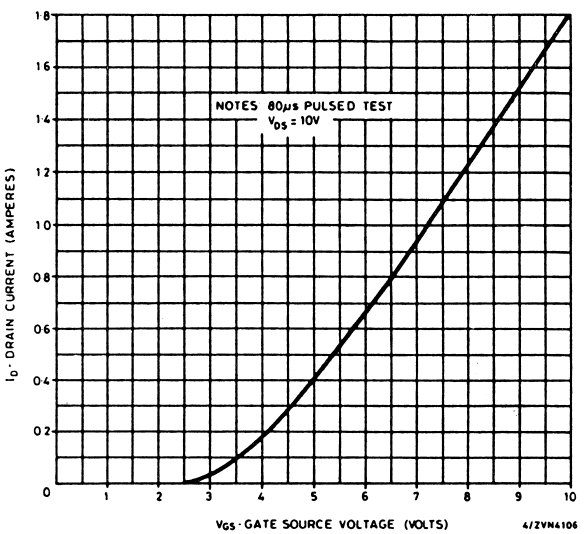


Fig 4. Typical transfer characteristics

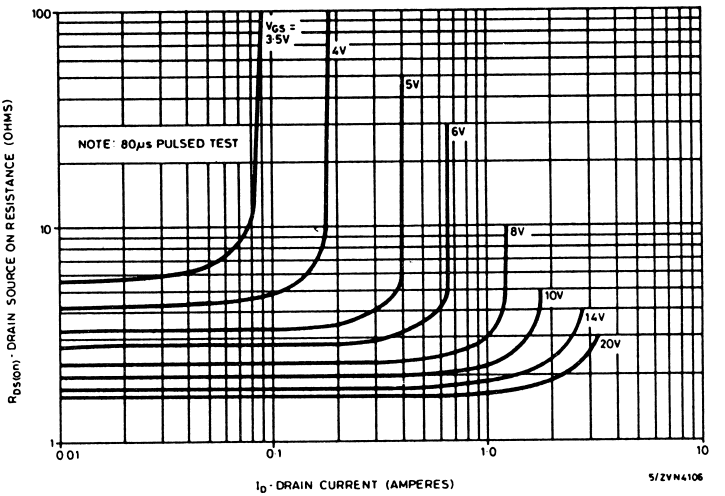


Fig. 5 Typical on-resistance v drain current

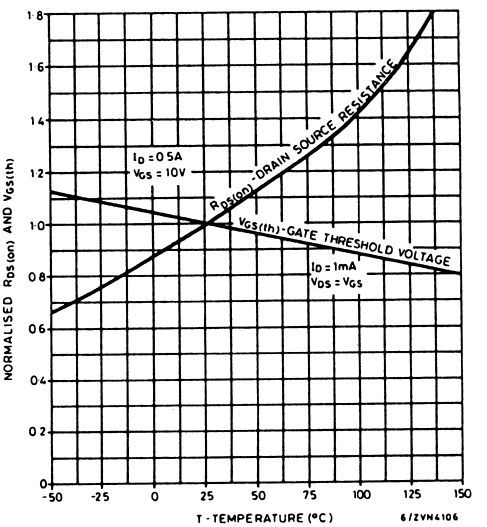


Fig 6. Normalised $R_{DS(on)}$ and $V_{GS(th)}$ v temperature

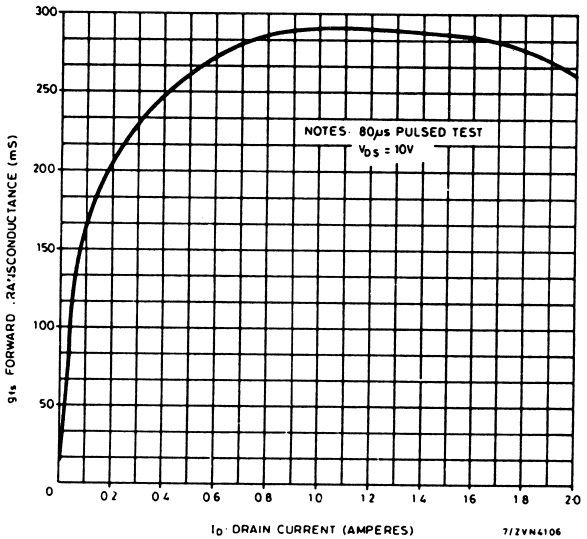


Fig 7. Typical transconductance v drain current

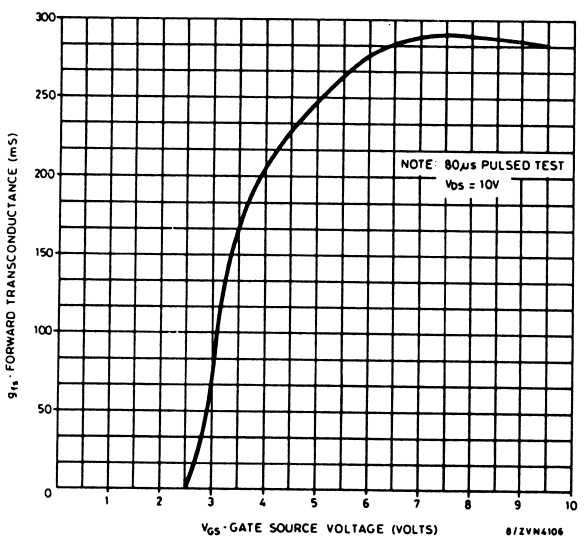


Fig 8. Typical transconductance v gate-source voltage

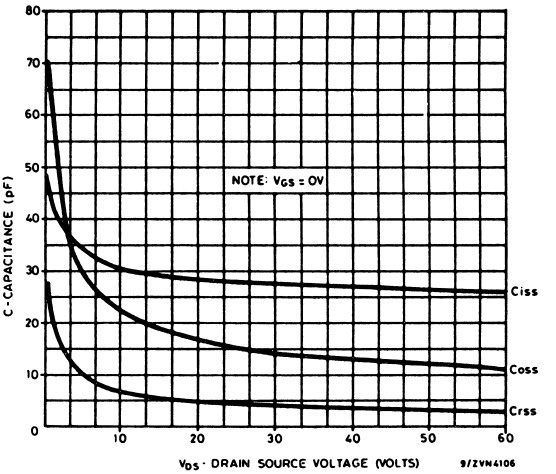


Fig. 9 Typical capacitance v drain-source voltage

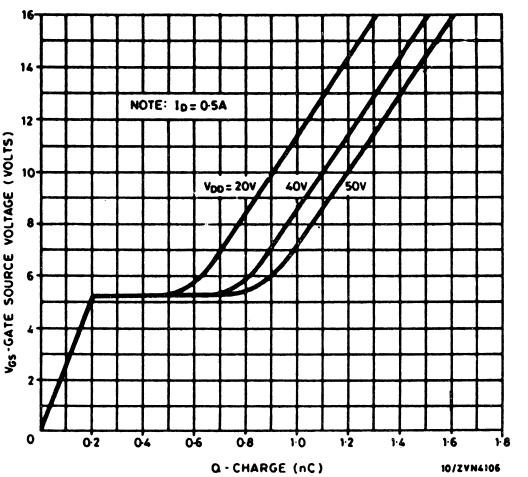


Fig. 10 Typical gate charge v gate-source voltage

P-channel enhancement mode vertical DMOS FET

ZVP1320F

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	SOT-23	Unit
Drain-source voltage	V_{DS}	−200	V
Continuous drain current (at T_A=25°C)	I_D	−0.035	A
Pulse drain current	I_{DM}	−0.4	A
Gate-source voltage	V_{GS}	±20	V

ELECTRICAL CHARACTERISTICS (at T=25°C unless otherwise stated).

Parameter	Symbol	Min.	Max.	Unit	Conditions
Drain-source breakdown voltage	BV_{DSS}	−200	—	V	I_D=−1mA, V_{GS}=0V
Gate-source threshold voltage	$V_{GS(th)}$	−1.5	−3.5	V	I_D=−1mA, V_{DS}=V_{GS}
Gate body leakage	I_{GSS}	—	20	nA	V_{GS}=±20V, V_{DS}=0V
Zero gate voltage drain current	I_{DSS}	—	−10	μA	V_{DS}=Max. rating, V_{GS}=0V
		—	−50	μA	V_{DS}=0.8×Max. rating V_{GS}=0V (T=125°C) (2)
On-state drain current (1)	$I_{D(on)}$	−100	—	mA	V_{DS}=−25V, V_{GS}=−10V
Static drain-source on-state resistance (1)	$R_{DS(on)}$	—	80	Ω	I_D=−50mA, V_{GS}=−10V
Forward transconductance (1) (2)	g_{fs}	25	—	mS	V_{DS}=−25V, I_D=−50mA
Input capacitance (2)	C_{iss}	—	50	pF	V_{DS}=−25V, V_{GS}=0V f=1MHz
Common source output capacitance (2)	C_{oss}	—	15	pF	
Reverse transfer capacitance (2)	C_{rss}	—	5	pF	
Turn-on delay time (2) (3)	$t_{d(on)}$	—	8	ns	V_{DD}≈−25V, I_D=−50mA
Rise time (2) (3)	t_r	—	8	ns	
Turn-off delay time (2) (3)	$t_{d(off)}$	—	8	ns	
Fall time (2) (3)	t_f	—	16	ns	

(1) Measured under pulsed conditions. Width=300μs, Duty cycle≤2%.
(2) Sample test.
(3) Switching times measured with 50Ω source impedance and <5ns rise time on a pulse generator.

Devices are identified by a code on the body of the device

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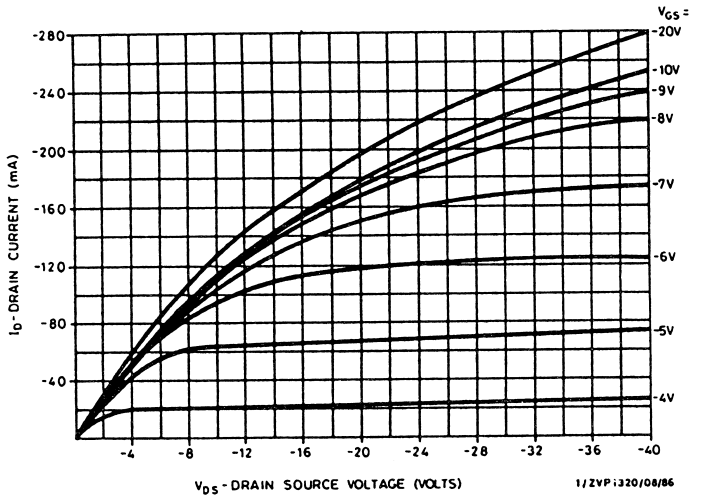

Fig 1. Typical output characteristics

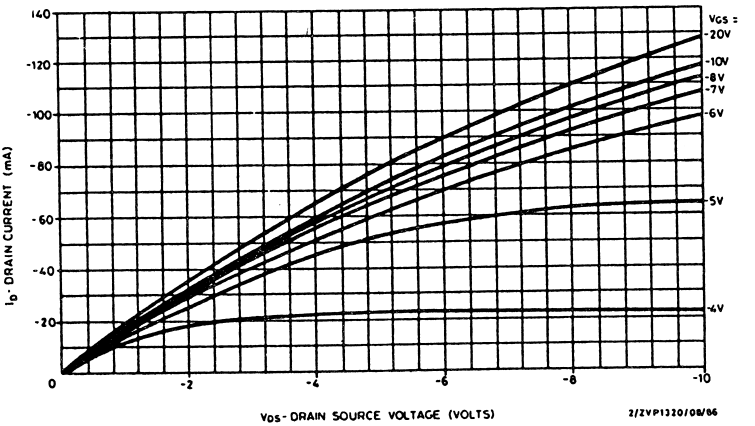

Fig 2. Typical saturation characteristics

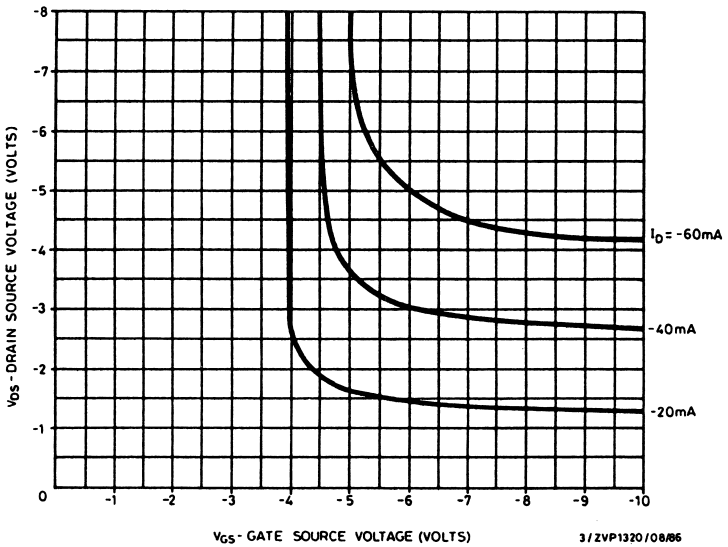

Fig 3. Typical voltage saturation characteristics

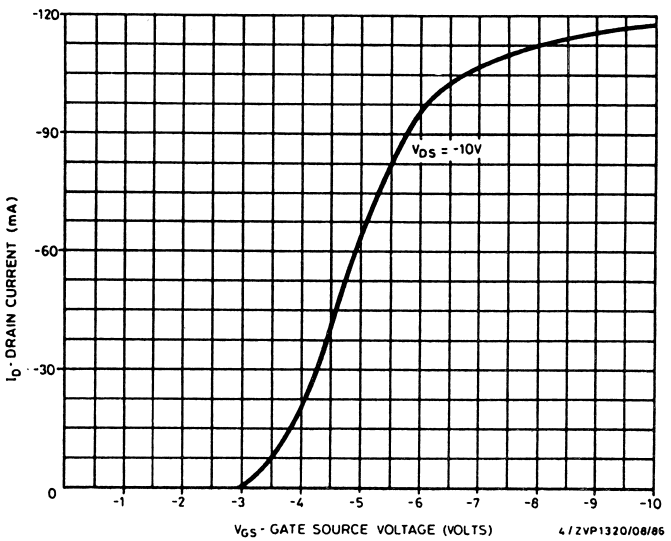

Fig 4. Typical transfer characteristics

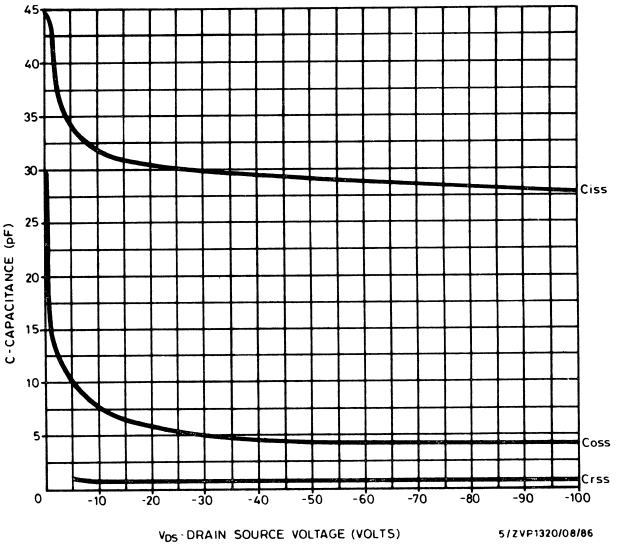

Fig 5. Typical capacitance v drain-source voltage

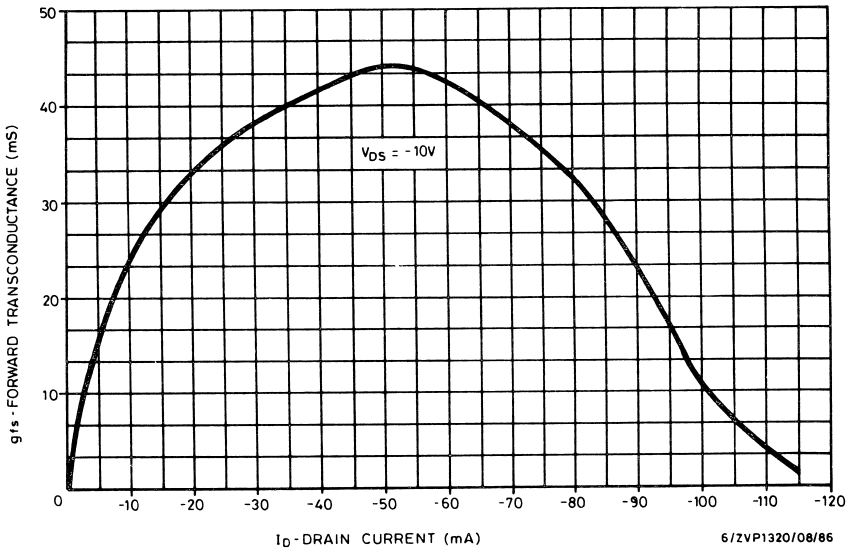

Fig 6. Typical transconductance v drain current

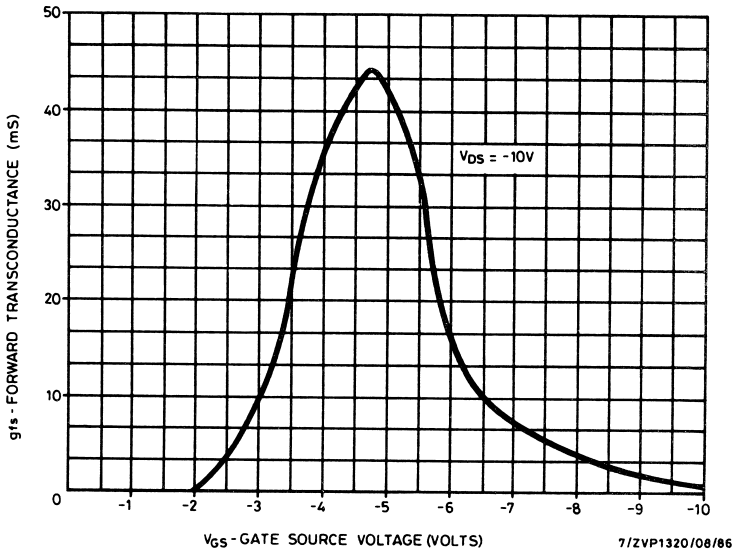

Fig 7. Typical transconductance v gate-source voltage

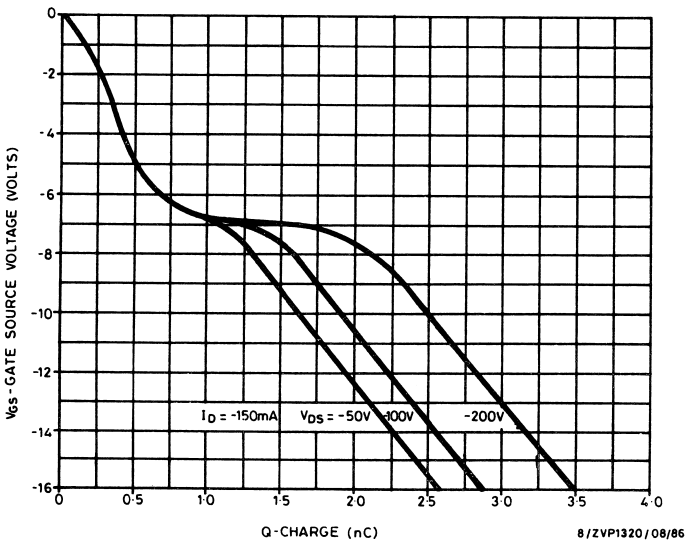

Fig 8. Typical gate charge v gate-source voltage

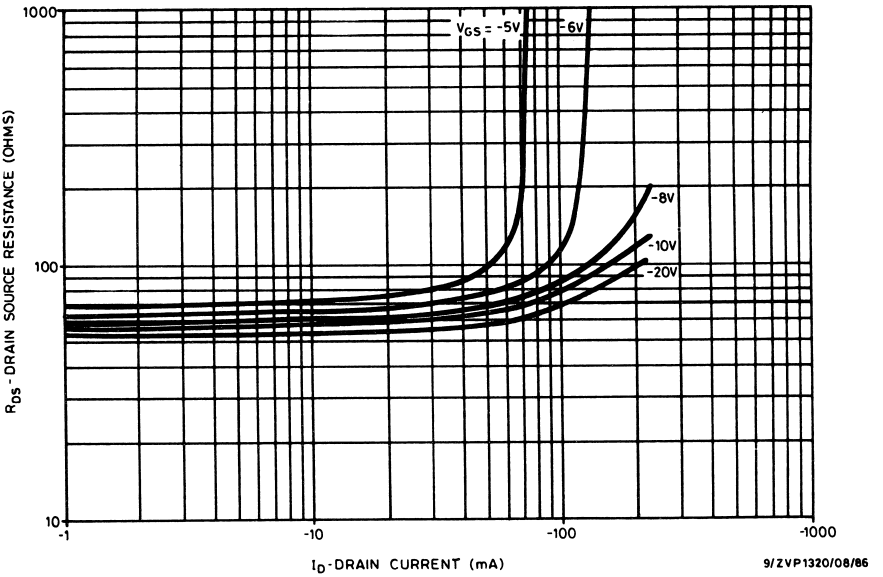

Fig. 9 Typical on-resistance v drain current

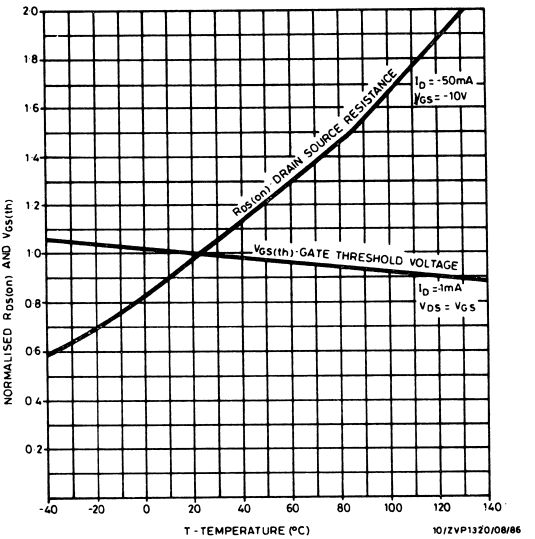

Fig. 10 Normalised $R_{DS(on)}$ and $V_{GS(th)}$ v temperature

P-channel enhancement mode vertical DMOS FET

ZVP3306F

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	SOT-23	Unit
Drain-source voltage	V_{DS}	−60	V
Continuous drain current (at $T_A = 25°C$)	I_D	−0.09	A
Pulse drain current	I_{DM}	−1.6	A
Gate-source voltage	V_{GS}	±20	V

ELECTRICAL CHARACTERISTICS (at T=25°C unless otherwise stated).

Parameter	Symbol	Min.	Max.	Unit	Conditions
Drain-source breakdown voltage	BV_{DSS}	−60	—	V	$I_D = -1$ mA, $V_{GS} = 0$V
Gate-source threshold voltage	$V_{GS(th)}$	−1.5	−3.5	V	$I_D = -1$ mA, $V_{DS} = V_{GS}$
Gate body leakage	I_{GSS}	—	20	nA	$V_{GS} = \pm 20$V, $V_{DS} = 0$V
Zero gate voltage drain current	I_{DSS}	—	−0.5	μA	V_{DS} = Max. rating, $V_{GS} = 0$V
		—	−50	μA	$V_{DS} = 0.8 \times$ Max. rating, $V_{GS} = 0$V (T=125°C) (2)
On-state drain current (1)	$I_{D(on)}$	−400	—	mA	$V_{DS} = -18$V, $V_{GS} = -10$V
Static drain-source on-state resistance (1)	$R_{DS(on)}$	—	14	Ω	$I_D = -200$mA, $V_{GS} = -10$V
Forward transconductance (1) (2)	g_{fs}	60	—	mS	$V_{DS} = -18$V, $I_D = -200$mA
Input capacitance (2)	C_{iss}	—	50	pF	$V_{DS} = -18$V, $V_{GS} = 0$V, f=1 MHz
Common source output capacitance (2)	C_{oss}	—	25	pF	
Reverse transfer capacitance (2)	C_{rss}	—	8	pF	
Turn-on delay time (2) (3)	$t_{d(on)}$	—	8	ns	$V_{DD} \approx -18$V, $I_D = -200$mA
Rise time (2) (3)	t_r	—	8	ns	
Turn-off delay time (2) (3)	$t_{d(off)}$	—	8	ns	
Fall time (2) (3)	t_f	—	8	ns	

(1) Measured under pulsed conditions. Width=300μs, Duty cycle ≤ 2%.
(2) Sample test.
(3) Switching times measured with 50Ω source impedance and < 5ns rise time on a pulse generator.

Devices are identified by a code on the body of the device

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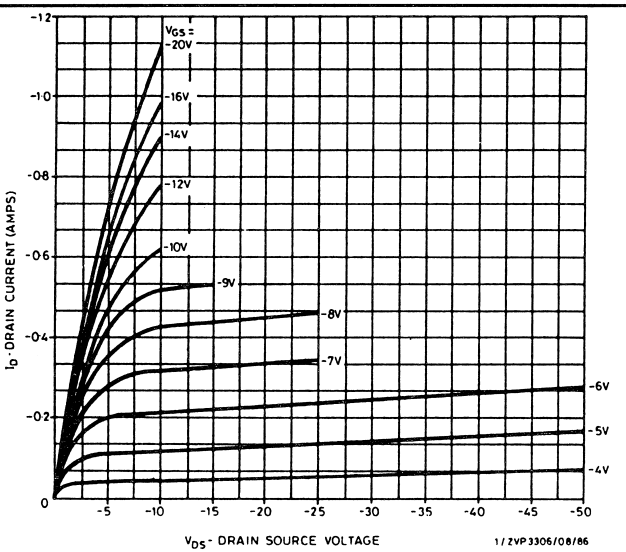

Fig 1. Typical output characteristics

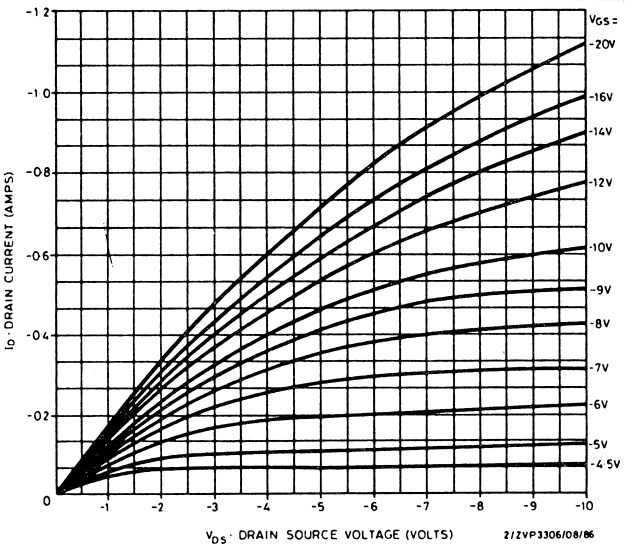

Fig 2. Typical saturation characteristics

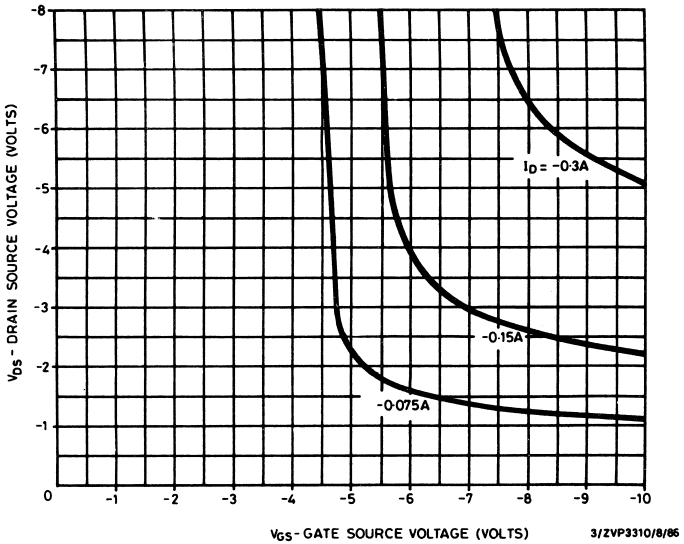

Fig 3. Typical voltage saturation characteristics

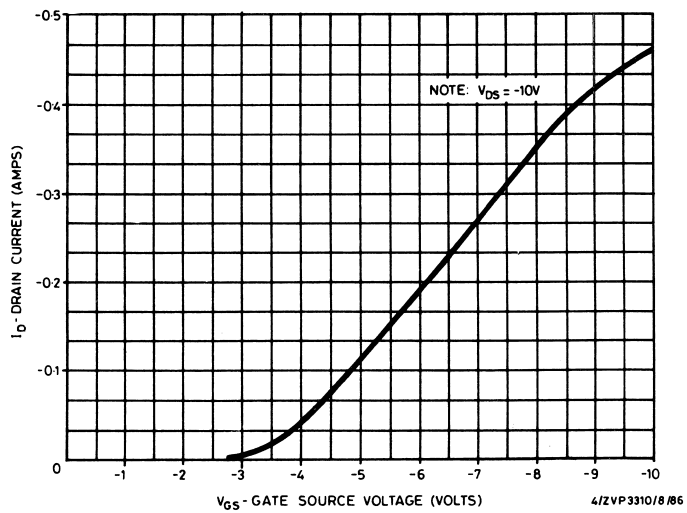

Fig 4. Typical transfer characteristics

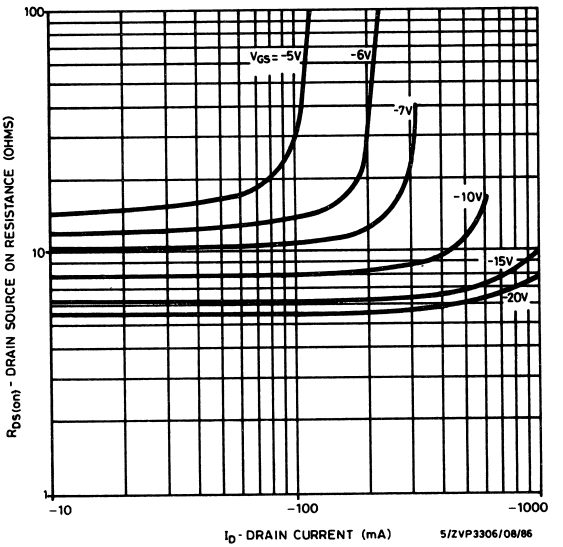

Fig 5. Typical on-resistance v drain current

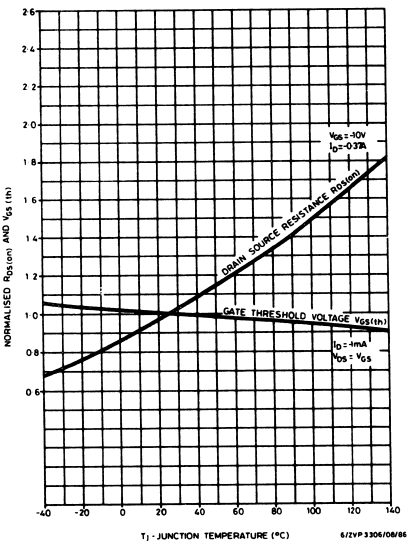

Fig 6. Normalised $R_{DS(on)}$ and $V_{GS(th)}$ v temperature

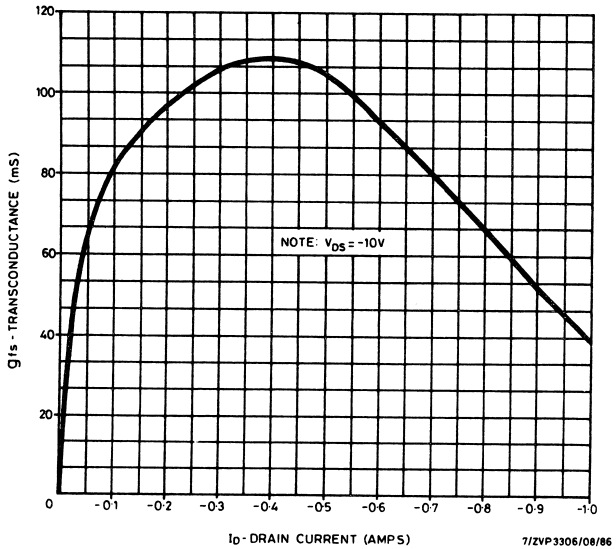

Fig 7. Typical transconductance v drain current

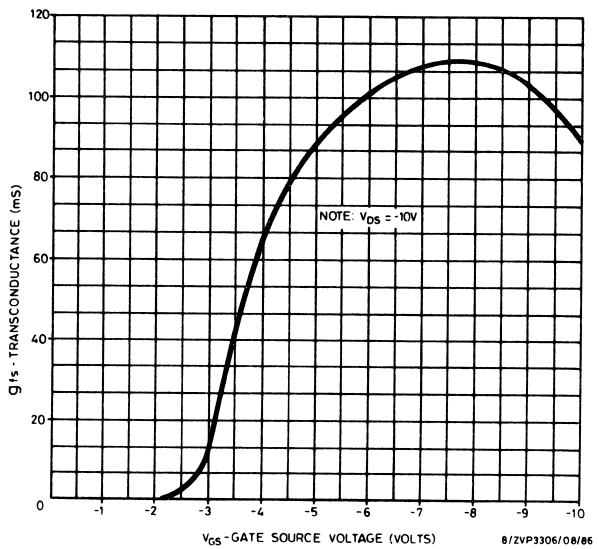

Fig 8. Typical transconductance v gate-source voltage

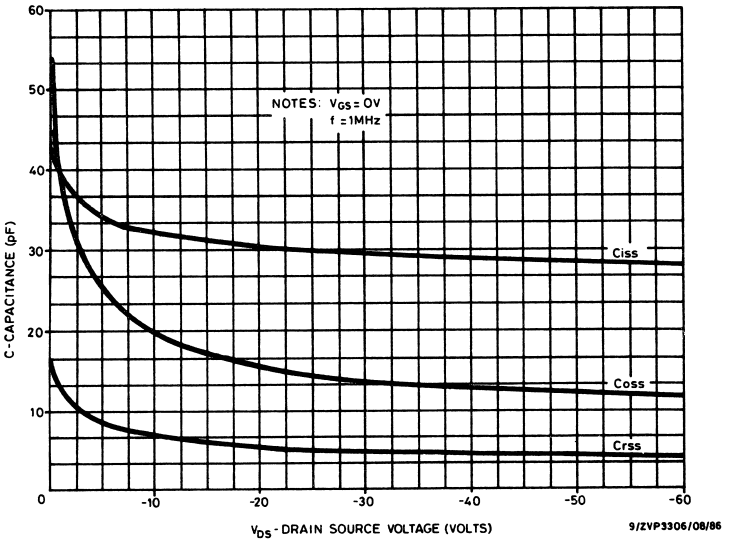

Fig. 9 Typical capacitance v drain-source voltage

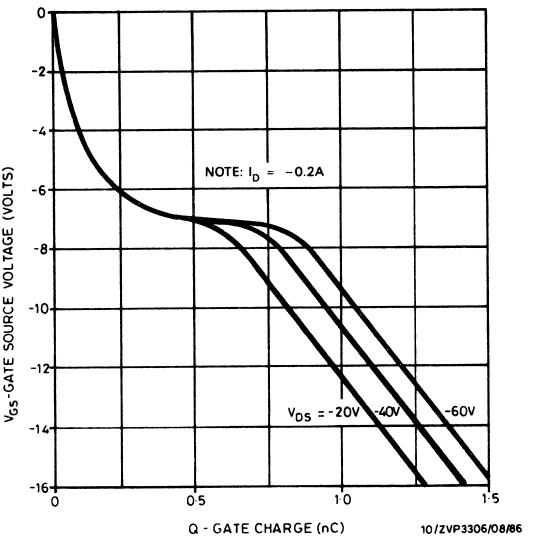

Fig. 10 Typical gate charge v gate-source voltage

P-channel enhancement mode vertical DMOS FET

ZVP3310F

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	SOT-23	Unit
Drain-source voltage	V_{DS}	−100	V
Continuous drain current (at $T_A = 25°C$)	I_D	−0.075	A
Pulse drain current	I_{DM}	−1.2	A
Gate-source voltage	V_{GS}	±20	V

ELECTRICAL CHARACTERISTICS (at T=25°C unless otherwise stated).

Parameter	Symbol	Min.	Max.	Unit	Conditions
Drain-source breakdown voltage	BV_{DSS}	−100	—	V	$I_D = -1$ mA, $V_{GS} = 0$V
Gate-source threshold voltage	$V_{GS(th)}$	−1.5	−3.5	V	$I_D = -1$ mA, $V_{DS} = V_{GS}$
Gate body leakage	I_{GSS}	—	20	nA	$V_{GS} = \pm 20$V, $V_{DS} = 0$V
Zero gate voltage drain current	I_{DSS}	—	−1	μA	V_{DS} = Max. rating, $V_{GS} = 0$V
		—	−50	μA	$V_{DS} = 0.8 \times$ Max. rating, $V_{GS} = 0$V (T=125°C) (2)
On-state drain current (1)	$I_{D(on)}$	−300	—	mA	$V_{DS} = -25$V, $V_{GS} = -10$V
Static drain-source on-state resistance (1)	$R_{DS(on)}$	—	20	Ω	$I_D = -150$mA, $V_{GS} = -10$V
Forward transconductance (1) (2)	g_{fs}	50	—	mS	$V_{DS} = -25$V, $I_D = -150$mA
Input capacitance (2)	C_{iss}	—	50	pF	$V_{DS} = -25$V, $V_{GS} = 0$V, f=1 MHz
Common source output capacitance (2)	C_{oss}	—	15	pF	
Reverse transfer capacitance (2)	C_{rss}	—	5	pF	
Turn-on delay time (2) (3)	$t_{d(on)}$	—	8	ns	$V_{DD} \approx -25$V, $I_D = -150$mA
Rise time (2) (3)	t_r	—	8	ns	
Turn-off delay time (2) (3)	$t_{d(off)}$	—	8	ns	
Fall time (2) (3)	t_f	—	8	ns	

(1) Measured under pulsed conditions. Width=300μs, Duty cycle ≤ 2%.
(2) Sample test.
(3) Switching times measured with 50Ω source impedance and < 5ns rise time on a pulse generator.

Devices are identified by a code on the body of the device

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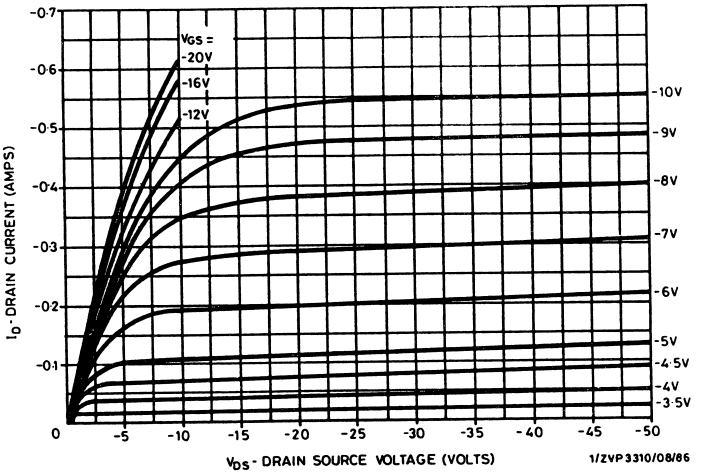


Fig 1. Typical output characteristics

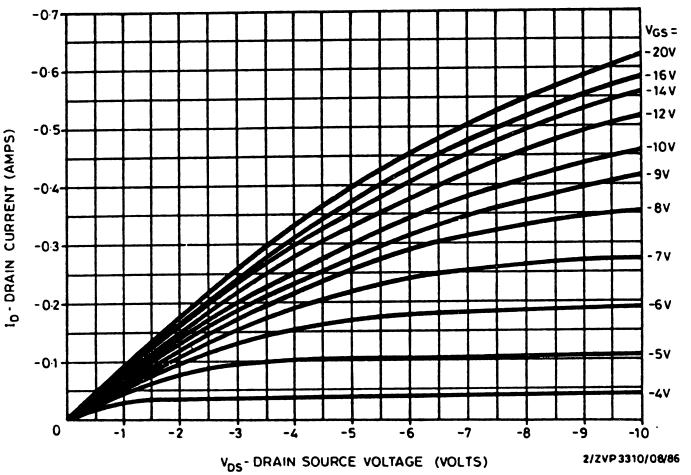


Fig 2. Typical saturation characteristics

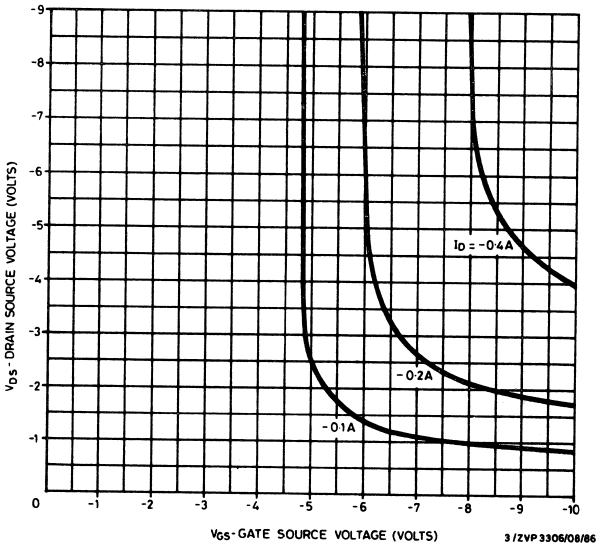


Fig 3. Typical voltage saturation characteristics

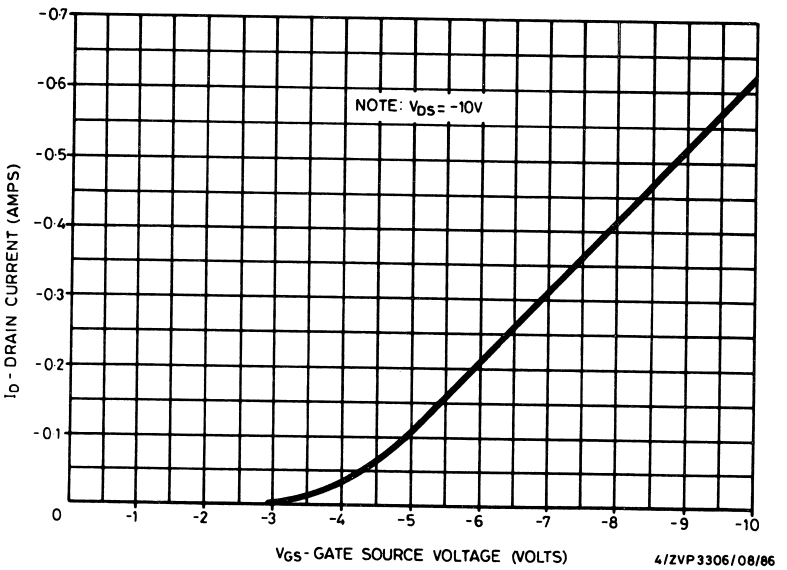


Fig 4. Typical transfer characteristics

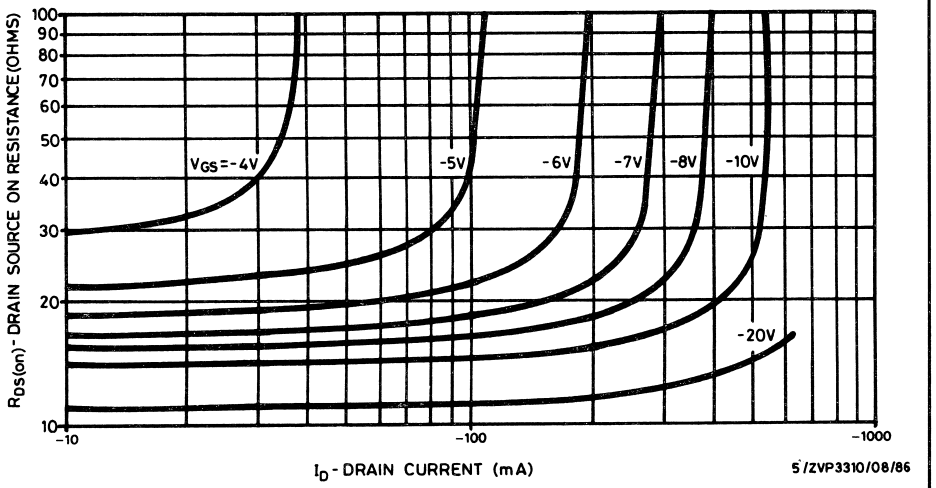


Fig 5. Typical on-resistance v drain current

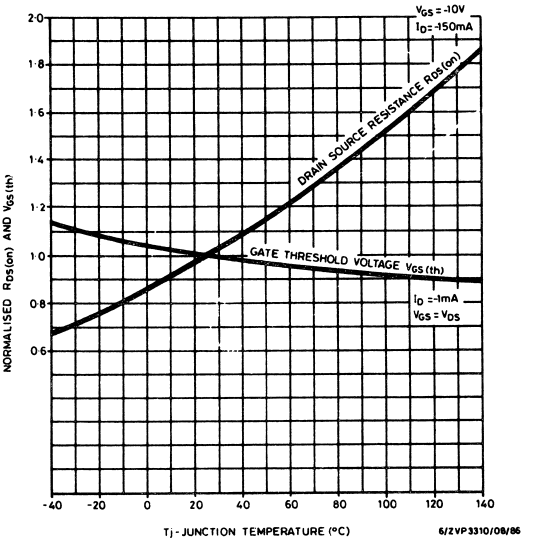


Fig 6. Normalised $R_{DS(on)}$ and $V_{GS(th)}$ v temperature

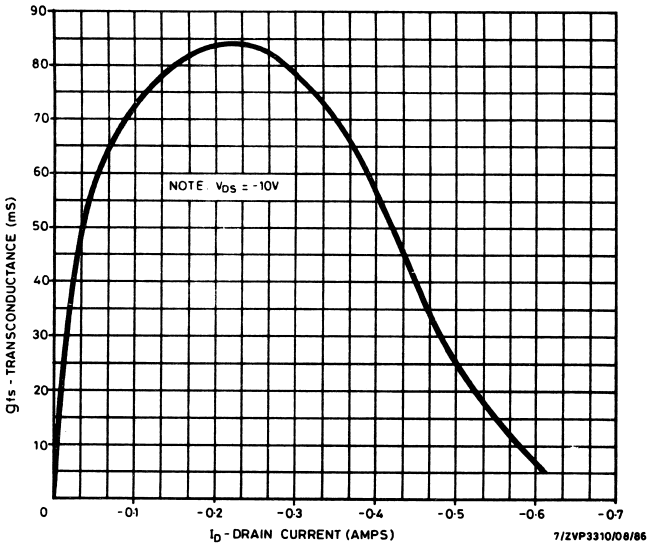


Fig 7. Typical transconductance v drain current

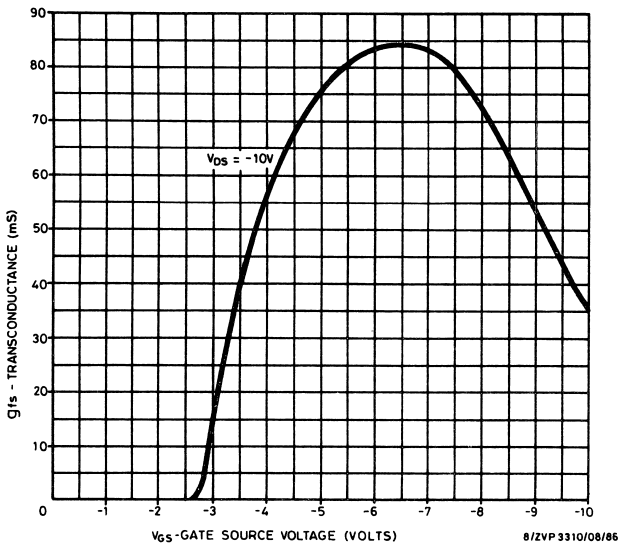


Fig 8. Typical transconductance v gate-source voltage

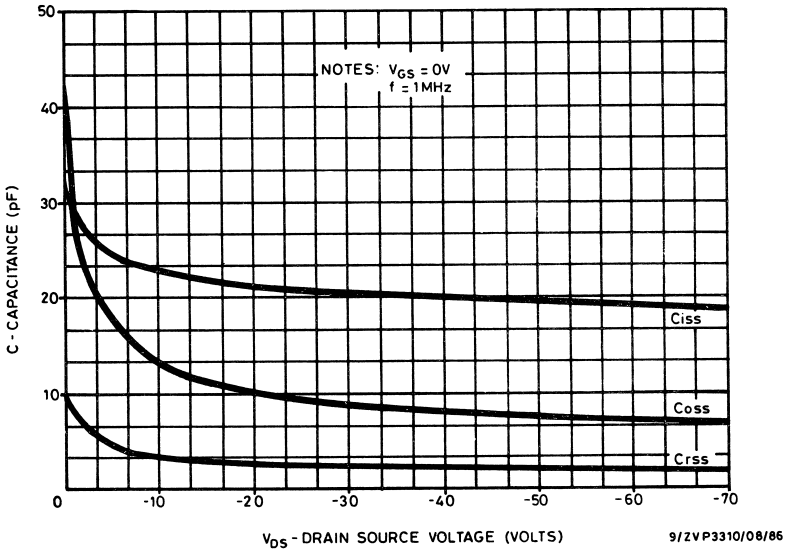


Fig. 9 Typical capacitance v drain-source voltage

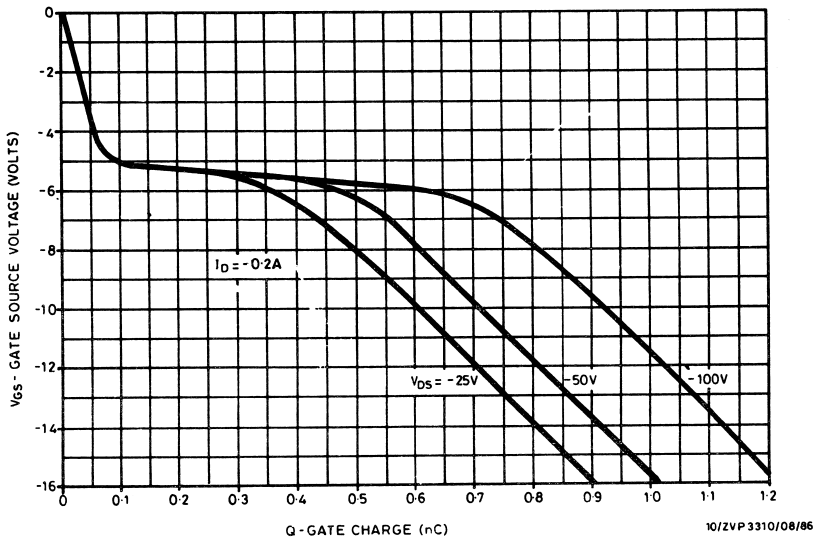


Fig. 10 Typical gate charge v gate-source voltage

N-channel enhancement mode vertical DMOS FET

ADVANCE PRODUCT INFORMATION

2N7002

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	2N7002	Unit
Drain-source voltage	V_{DS}	60	V
Continuous drain current (at $T_A = 25°C$)	I_D	115	mA
Pulsed drain current	I_{DM}	800	mA
Gate-source voltage	V_{GS}	±40	V
Maximum power dissipation (at $T_A = 25°C$)	P_D	200	mW
Operating/storage temperature range	T_j, T_{stg}	−55 to +150	°C

ELECTRICAL CHARACTERISTICS (at T=25°C unless otherwise stated).

Parameter	Symbol	Min.	Max.	Unit	Conditions
Drain-source breakdown voltage	BV_{DSS}	60	—	V	$I_D = 10\mu A$, $V_{GS} = 0V$
Gate-source threshold voltage	$V_{GS(th)}$	1.0	2.5	V	$I_D = 250\mu A$, $V_{DS} = V_{GS}$
Gate body leakage	I_{GSS}	—	100	nA	$V_{GS} = \pm 20V$, $V_{DS} = 0V$
Zero gate voltage drain current	I_{DSS}	—	1	μA	V_{DS} = Max. rating, $V_{GS} = 0V$
		—	500	μA	V_{DS} = Max. rating, $V_{GS} = 0V$ (T=125°C) (2)
On-state drain current (1)	$I_{D(on)}$	500	—	mA	$V_{DS} = 25V$, $V_{GS} = 10V$
Static drain-source on-state voltage (1)	$V_{DS(on)}$	—	3.75	V	$V_{GS} = 10V$, $I_D = -500mA$
		—	0.375	V	$V_{GS} = 5V$, $I_D = 50mA$
Static drain-source on-state resistance (1)	$R_{DS(on)}$	—	7.5	Ω	$I_D = 500mA$, $V_{GS} = 10V$
		—	7.5	Ω	$I_D = 50mA$, $V_{GS} = 5V$
Forward transconductance (1) (2)	g_{fs}	80	—	mS	$V_{DS} = 25V$, $I_D = 500mA$
Input capacitance (2)	C_{iss}	—	50	pF	$V_{DS} = 25V$, $V_{GS} = 0V$ f=1 MHz
Common source output capacitance (2)	C_{oss}	—	25	pF	
Reverse transfer capacitance (2)	C_{rss}	—	5	pF	
Turn-on time (2)	$t_{(on)}$	—	20	ns	$V_{DD} \approx 30V$, $I_D = 200mA$ $R_g = 25\Omega$, $R_L = 150\Omega$
Turn-off time (2)	$t_{(off)}$	—	20	ns	

(1) Measured under pulsed conditions. Width=300μs, Duty cycle ⩽ 2%.
(2) Sample test.

Devices are identified by a code on the body of the device

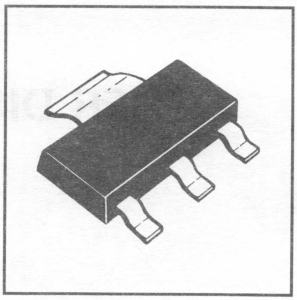
2N7002 702

OTHER DISCRETE SURFACE MOUNT COMPONENTS

1. SOT-223
2. SOT-89
3. E-LINE (Centre Collector/Drain) 'SM'
4. E-LINE (Centre Base/Gate) 'M1'

SOT-223

GENERAL INFORMATION



As surface mount continues to increase its penetration throughout the world of electronics, the SOT-223 is one of many surface mount packages which are the driving force behind this phenomenal growth.

The package is capable of housing semiconductor crystals up to 2.5 x 2.5mm offering power capabilities up to and above 2W (subject to mounting).

Designed in a similar fashion to the very popular SOT-23 package, it ensures that it is fully compatible with all industry standard wave and reflow soldering techniques.

The initial range of SOT-223 products covers mainly bipolar types plus selected MOSFETs. The complete bipolar range combines the Zetex pioneered 'Matrix' chip design together with the rugged SOT-223 package, giving the circuit designer maximum flexibility in designing wholly surface mount circuits using a proven, reliable and rugged product.

Features of SOT-223

- ★ Power Capabilities up to 2W
  $R_{th(j\text{-}amb)}$ 60°C/W
  $R_{th(j\text{-}case)}$ 15°C/W
- ★ Can accommodate chip sizes up to 2.5 by 2.5mm.
- ★ Compatible with industry standard assembly techniques.
- ★ Footprint compatibility with D-PAK.

NEW PRODUCTS

The continued evolution of new products means that our range is constantly updated. If your particular requirement is not covered herein, please do not hesitate to contact us for new product information.

Customer Specifications

Devices may be supplied against 'in-house' specifications to suit individual customer requirements for:

- ★ Non-standard Electrical or Environmental Specifications.
- ★ Customer Procurement Specifications.

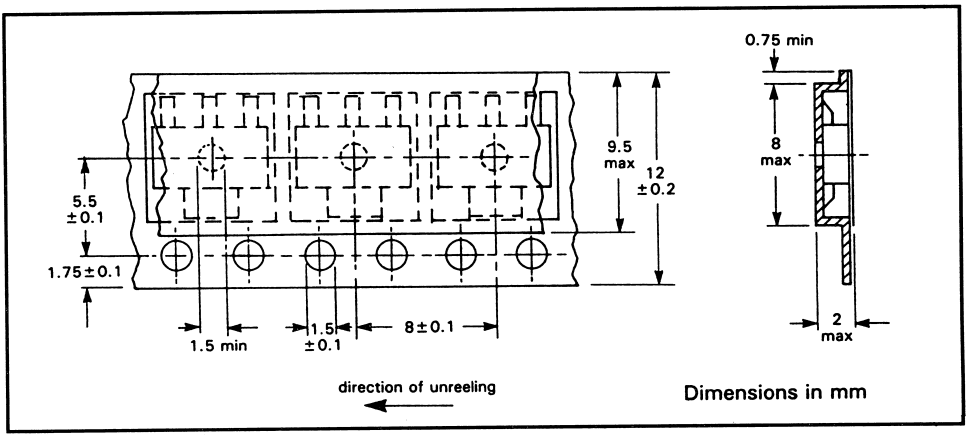
TAPE AND REEL INFORMATION

The complete range of SOT-223 devices is available on 12mm tape for use with automatic placement equipment. Available on either 7in. or 13in. reels, ordering information is as follows:

e.g. FZT649TA 7in. reel 1000 components/reel.
FZT649TC 13in. reel 2500 components/reel.

1 SOT-223

Tape Specification



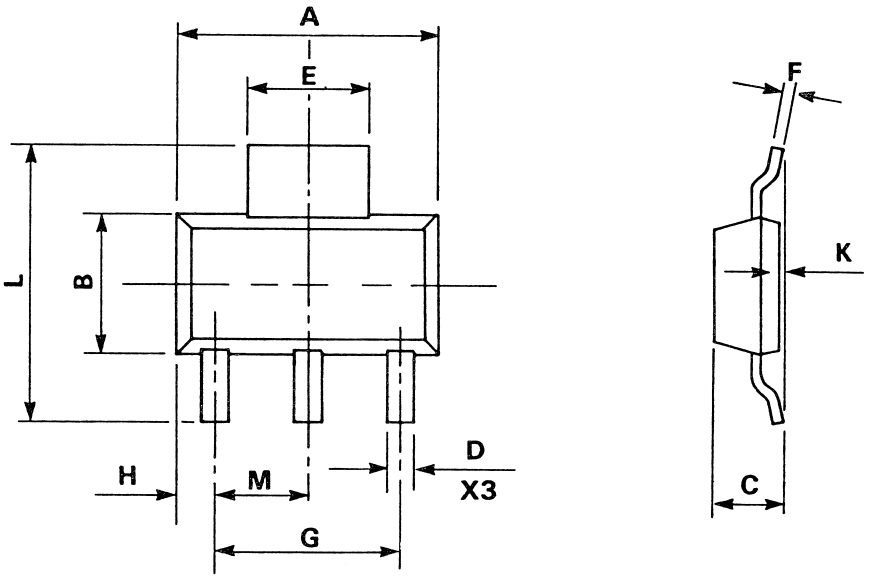
MAXIMUM THERMAL RATINGS

Junction Temperature ..... 150°C

Operating and Storage Temperature ..... −55°C to +150°C

SOT-223

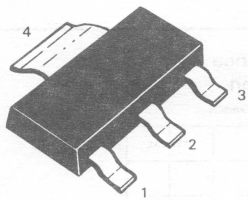
PACKAGE OUTLINE DETAILS

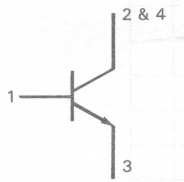


DIM	Millimetres		Inches	
	Min.	Max.	Min.	Max.
A	6.3	6.7	0.248	0.264
B	3.3	3.7	0.130	0.146
C	–	1.7	–	0.067
D	0.6	0.8	0.024	0.031
E	2.9	3.1	0.114	0.122
F	0.24	0.32	0.009	0.013
G	4.6 NOM		0.181 NOM	
H	0.85	1.05	0.033	0.041
K	0.02	0.10	0.0008	0.004
L	6.7	7.3	0.264	0.287
M	2.3 NOM		0.0905 NOM	

PIN CONNECTIONS

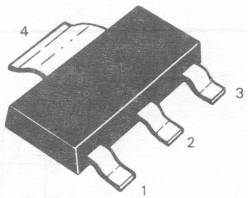
BIPOLAR TRANSISTORS

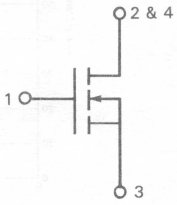




1 BASE
2 COLLECTOR
3 EMITTER
4 COLLECTOR

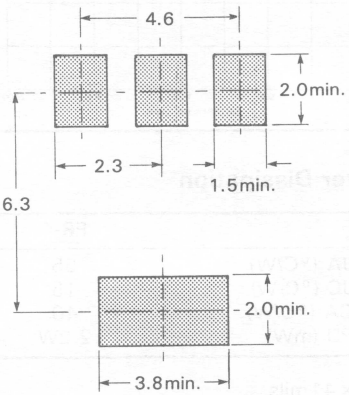
MOSFETs





1 GATE
2 DRAIN
3 SOURCE
4 DRAIN

PAD LAYOUT

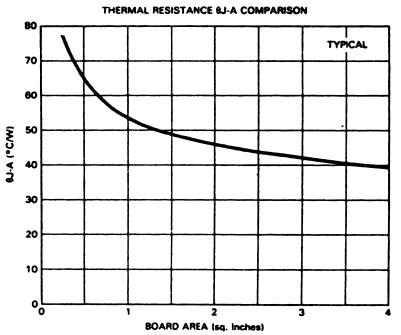


Minimum Pad Sizes (dimensions in mm)

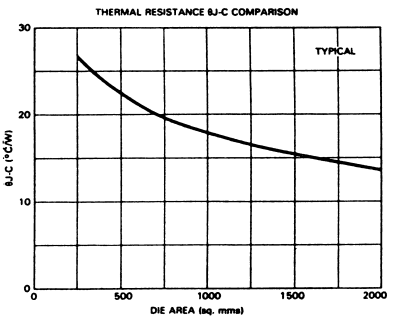
THERMAL DATA

The power dissipation is dependant on many factors that must be taken into consideration in the initial board design. The board material, the board surface, metal thickness, pad area and the proximity to other heat generating components all have a bearing on the device dissipation capability.

Thermal Resistance
θJA comparison



Thermal Resistance
θJC



Thermal Ratings and Power Dissipation

	FR-4
θJA (°C/W)	55
θJC (°C/W)	15
θCA (°C/W)	40
PD (mW)	2.2W

Typical Example: Die Size = 41 × 41 mils
FR4 = 1″ × 1″ × 0.060″
P_D = $T_{J(max.)} - TA/R\theta JA$

NPN TRANSISTORS (INCLUDING DARLINGTON)

Type	V_{CBO} V	V_{CEO} V	$I_{C(cont)}$ A	I_{CM} A	P_{tot} W	h_{FE} Min./Max. at I_C/V_{CE}	mA/Volts	$V_{CE(sat)}$ Max. at I_C/I_B Volts	mA	f_T Min. MHz	Comple-ment
FZT657	300	300	0.5	1.0	2.0	50/-	100/5	0.5	100/10	30	FZT757
FZT655	150	150	1.0	2.0	2.0	50/- 20/-	500/5 1000/5	0.5 0.5	500/50 1000/200	30 30	FZT755
FZT605*	140	120	2.0	4.0	2.0	5K/- 2K/100K	500/5 1000/5	1.0 1.5	250/0.25 1000/1.0	150	FZT705*
FZT653	120	100	2.0	6.0	2.0	100/300 25/-	500/2 2000/2	0.3 0.5	1000/100 2000/200	140 140	FZT753
FZT651	80	60	3.0	6.0	2.0	80/- 40/-	1000/2 2000/2	0.3 0.6	1000/100 3000/300	140	FZT751
FZT649	35	25	3.0	8.0	2.0	100/300 15/-	1000/2 6000/2	0.3 0.6	1000/100 3000/300	150	FZT749

*Darlington

PNP TRANSISTORS (INCLUDING DARLINGTON)

Type	V_{CBO} V	V_{CEO} V	$I_{C(cont)}$ A	I_{CM} A	P_{tot} W	h_{FE} Min./Max. at I_C/V_{CE}	mA/Volts	$V_{CE(sat)}$ Max. at I_C/I_B Volts	mA	f_T Min. MHz	Comple-ment
FZT757	-300	-300	-0.5	-1.0	2.0	50/-	-100/-5	-0.5	-100/-10	30	FZT657
FZT755	-150	-150	-1.0	-2.0	2.0	50/- 20/-	-500/-5 -1000/-5	-0.5 -0.5	-500/-50 -1000/-200	30	FZT655
FZT705*	-140	-120	-2.0	-4.0	2.0	3K/30k 2K/-	-1000/-5 -2000/-5	-1.3 -2.5	-1000/-1.0 -2000/-2.0	100	FZT605*
FZT753	-120	-100	-2.0	-6.0	2.0	100/300 25/-	-500/-2 -2000/-2	-0.3 -0.5	-1000/-100 -2000/-200	100	FZT653
FZT751	-80	-60	-3.0	-6.0	2.0	80/- 40/-	-1000/-2 -2000/-2	-0.3 -0.6	-1000/-100 -3000/-300	100	FZT651
FZT749	-5	-25	-3.0	-8.0	2.0	100/300 15/-	-1000/-2 -6000/-2	-0.3 -0.6	-1000/-100 -3000/-300	100	FZT649

*Darlington

MOSFETs

Type	BV_{DSS} V	I_D A	I_{DM} A	P_{tot} W	$V_{GS(th)}$ V at I_D Min.	Max.	mA	$R_{DS(on)}$ Ω at I_D Max.	A	V_{GS} V	Comple-ment
N-channel											
ZVN2106G	60	0.7	8	2	0.8	2.4	1.0	2.0	1.0	10	ZVP2106G
P-channel											
ZVP2106G	-60	-0.45	-4	2	-1.5	-3.5	-1.0	5.0	-0.5	-10	ZVN2106G

SOT-223 CROSS REFERENCE LIST

COMPETITION CROSS REFERENCE GUIDE

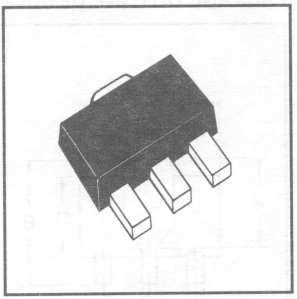
Competition Part	Zetex Part
MOTOROLA (ALL D-PAK)	
MJD29	FZT653
MJD29C	FZT653
MJD30	FZT753
MJD30C	FZT753
MJD31	FZT653
MJD31C	FZT653
MJD32	FZT753
MJD32C	FZT753
MJD41	FZT653
MJD42C	FZT753
MJD47	FZT657
MJD112	FZT605
MJD117	FZT705
MJD200	FZT651
MJD201	FZT751
MJD340	FZT657
MJD350	FZT757
PHILIPS	
BCP51	FZT753*
BCP52	FZT753*
BCP53	FZT753*
BCP54	FZT653*
BCP55	FZT653*
BCP56	FZT653*
BCP68	FZT649*
BCP69	FZT749*
BDS60	FZT705
BDS60A	FZT705
BDS60B	FZT705
BDS60C	FZT705
BDS61	FZT605
BDS61A	FZT605
BDS61B	FZT605
BDS61C	FZT605
BDS77	FZT653
BDS78	FZT753
BDS201	FZT653
BDS202	FZT753
BDS203	FZT653
BDS204	FZT753
BDS933	FZT653
BDS934	FZT753
BDS935	FZT653
BDS936	FZT753
BDS937	FZT653
BDS938	FZT753
BDS939	FZT653
BDS940	FZT753
BDS941	FZT655
BDS942	FZT755
BDS943	FZT649
BDS944	FZT749
BDS945	FZT651
BDS946	FZT751
BDS947	FZT651
BDS948	FZT751
BF720	FZT657*
BF721	FZT657*
BF722	FZT757*
BF723	FZT757*
BSP15	FZT757*
BSP16	FZT757*
BSP19	FZT657*
BSP20	FZT657*
BSP30	FZT753*
BSP31	FZT753*
BSP32	FZT753*
BSP33	FZT753*
BSP40	FZT653*
BSP41	FZT653*
BSP42	FZT653*
BSP43	FZT653*
BSP50	FZT605*
BSP51	FZT605*
BSP52	FZT605*
BSP60	FZT705*
BSP61	FZT705*
BSP62	FZT705*
BSP88	ZVNL120G
BSP89	ZVNL120G
BSP92	ZVP2120G
SIEMENS	
BCP28	FZT705†
BCP29	FZT605†
BCP48	FZT705†
BCP49	FZT605†
BCP51	FZT753*
BCP52	FZT753*
BCP53	FZT753*
BCP54	FZT653*
BCP55	FZT653*
BCP56	FZT653*
BCP68	FZT649*
BCP69	FZT749*
BF720	FZT657*
BF721	FZT657*
BF722	FZT757*
BF723	FZT757*
BFN36	FZT657*
BFN37	FZT757*
BFN38	FZT657*
BFN39	FZT757*
BSP50	FZT605*
BSP51	FZT605*
BSP52	FZT605*
BSP60	FZT705*
BSP61	FZT705*
BSP62	FZT705*
BSP88	ZVNL120
BSP89	ZVNL120
BSP92	ZVP2120

*Improved Electrical Performance †Higher current, lower h_{FE} alternative

2 SOT-89

GENERAL INTRODUCTION

The SOT-89 package offers the designer a solution to his requirements where a surface mount package, requiring 1 watt power dissipation, assembled using Reflow Techniques, is required.



NEW PRODUCTS

The continued evolution of new products means that our range is constantly updated. If your particular requirement is not covered herein, please do not hesitate to contact us for new product information.

Customer Specifications

Devices may be supplied against 'in-house' specifications to suit individual customer requirements for:

- ★ Non-standard Electrical or Environmental Specifications
- ★ Customer Procurement Specification

TAPE AND REEL INFORMATION

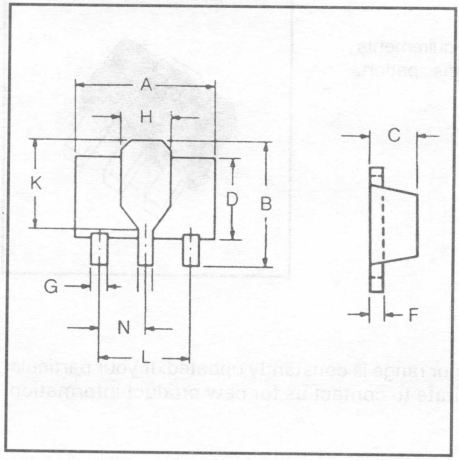
The complete range of SOT-89 devices is available on 12mm tape for use with automatic placement equipment. Available on either 7″ or 13″ reels, ordering information as follows:

e.g. BCX56TA 7″ Reel 1000 components/reel
BCX56TC 13″ Reel 2500 components/reel

Tape specification complies with Industry standards.

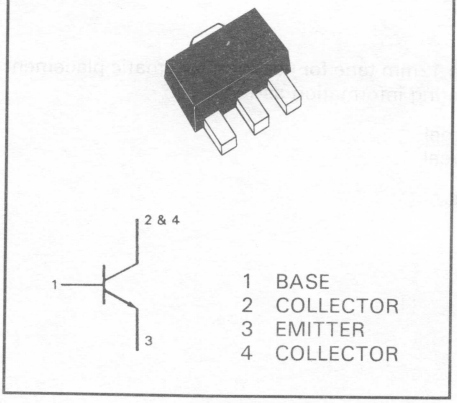
SOT-89

PACKAGE OUTLINE DETAILS

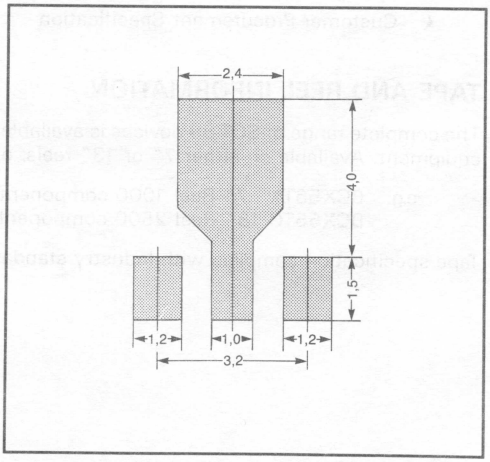


DIM.	MILLIMETRES		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	4.40	4.60	0.173	0.181
B	—	4.25	—	0.167
C	1.40	1.60	0.55	0.63
D	—	2.60	—	0.102
F	0.25	0.39	0.0098	0.015
G	0.40	0.65	0.016	0.026
H	1.50	1.70	0.059	0.067
K	2.60	2.85	0.91	0.112
L	2.90	3.10	0.114	0.122
N	1.40	1.60	0.55	0.63

PIN CONNECTIONS



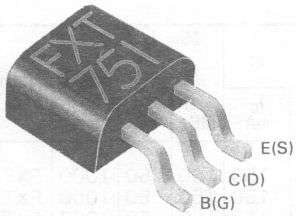
PAD LAYOUT

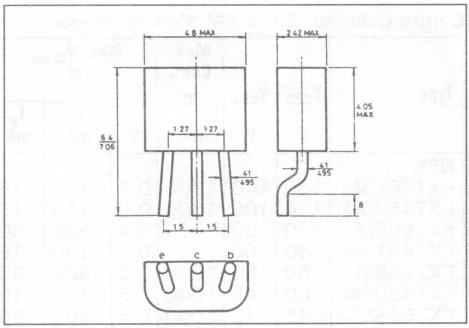


SOT-89

Type	V_{CBO} V	V_{CEO} V	I_C mA	P_{tot} mW	h_{FE} min./max.	h_{FE} at I_C/V_{CE} mA/volts	$V_{CE(sat)}$ max. at I_C/I_B Volts	$V_{CE(sat)}$ max. at I_C/I_B mA	f_T typ. MHz
NPN									
BCX56	100	80	1000	1000	40/250	150/2	0.5	500/50	100
BCX55	60	60	1000	1000	40/250	150/2	0.5	500/50	100
BCX54	45	45	1000	1000	40/250	150/2	0.5	500/50	100
BCX68	20	20	1000	1000	85/375	500/1	0.5	1000/100	100
PNP									
BCX53	100	80	1000	1000	40/250	150/2	0.5	500/50	125
BCX52	60	60	1000	1000	40/250	150/2	0.5	500/50	125
BCX51	45	45	1000	1000	40/250	150/2	0.5	500/50	125
BCX69	20	20	1000	1000	85/375	500/1	0.5	1000/100	100

3 CENTRE COLLECTOR E-LINE 'SM'

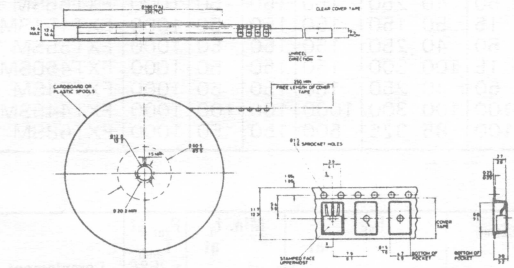




The E-line S.M. outline provides designers with the wide choice of Zetex E-line and Super E-line transistors in a surface mountable form compatible with the SOT-89 footprint. Direct electrical equivalents of popular SOT-89 types are available in E-line S.M.

In many applications E-line S.M. can be used to replace SOT-194, SOT-223 and DPAK.

TAPE SPECIFICATION



TAPE FEATURES

- Conforms to EIA 481. Rev A and IEC 286
- Start of tape will have 63 to 70 sealed empty pockets
- End of tape on reel hub will have 26 min. sealed empty pockets
- 7″ reel to hold 500 components
- 13″ reel to hold 3000 components
- Peel off strength of cover tape is 0.4 ± 0.3 newtons measured at 175°-180° with respect to the component carrier along the longitudinal axis of the carrier tape. The peel-off speed shall be 120 ± 5mm/min.
- Semi-conductive carrier tape resistivity less than $10^7\Omega/\square$

ORDERING INFORMATION

FXT651SMTA 7″ Reel 500/RL.
FXT651SMTC 13″ Reel 3000/RL.

SOLDERING RECOMMENDATIONS

Reflow soldering

E-line S.M. packages may be placed in any orientation using reflow techniques.

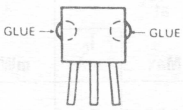
To maintain the position of the component, it may be advisable to glue the device prior to reflow.

Wave soldering

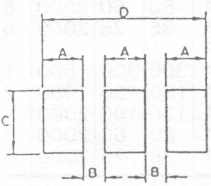
The preferred orientation for wave soldering is with the feet facing the wave. The component may also be positioned at right angles to the wave. An extra sacrificial pad may be necessary to avoid bridging between the leads when used in this orientation.

Gluing recommendations

Glue dots at either side of the package are recommended.



RECOMMENDED FOOTPRINTS FOR WAVE AND REFLOW SOLDERING



	A	B	C	D	
Wave soldering	1.0	0.5	1.5	4.0	mm
	40	20	60	160	mils
Reflow soldering	0.8	0.7	1.2	3.8	mm
	32	28	48	150	mils

CENTRE COLLECTOR E-LINE 'SM' 3

Centre Collector E-line SM Medium Power

Type	V_{CBO} V	V_{CEO} V	Max. Cont. I_C mA	Max. $V_{CE(sat)}$ at V	I_C mA	I_B mA	h_{FE} Min.	Max.	at I_C mA	Min. f_T at MHz	I_C mA	P_{tot} at T_{amb} =25°C mW	Complement
NPN													
FXT455SM	160	140	1000	0.2	150	15	100	300	150	100	50	1000	FXT555SM
FXT453SM	120	100	1000	0.2	150	15	40	200	150	150	50	1000	FXT553SM
FXT56SM	100	80	1000	0.5	500	50	40	250	150	150	50	1000	FXT53SM
FXT451SM	80	60	1000	0.5	150	15	50	150	150	150	50	1000	FXT551SM
FXT55SM	60	60	1000	0.5	500	50	40	250	150	150	50	1000	FXT52SM
FXT450SM	60	45	1000	0.5	150	15	100	300	150	50	50	1000	FXT550SM
FXT54SM	45	45	1000	0.5	500	50	40	250	150	150	50	1000	FXT51SM
FXT449SM	50	30	1000	0.5	1000	100	100	300	500	150	50	1000	FXT549SM
FXT68SM	25	20	1000	0.5	1000	100	85	375	500	150	50	1000	FXT69SM
PNP													
FXT557SM	300	300	500	0.3	50	5	50	300	50	75	50	1000	–
FXT555SM	160	150	1000	0.3	100	10	50	300	300	100	50	1000	FXT455SM
FXT553SM	120	100	1000	0.3	150	15	50	200	150	150	50	1000	FXT453SM
FXT53SM	100	80	1000	0.5	500	50	40	250	150	150	50	1000	FXT56SM
FXT551SM	80	60	1000	0.5	150	15	50	150	150	150	50	1000	FXT451SM
FXT52SM	60	60	1000	0.5	500	50	40	250	150	150	50	1000	FXT55SM
FXT550SM	60	45	1000	0.5	150	15	100	300	150	150	50	1000	FXT450SM
FXT51SM	45	45	1000	0.5	500	50	40	250	150	150	50	1000	FXT54SM
FXT549SM	35	30	1000	0.5	1000	100	100	300	1000	100	100	1000	FXT449SM
FXT69SM	25	20	1000	0.5	1000	100	85	375	500	150	50	1000	FXT68SM

Centre Collector E-line SM Super E-line

Type	V_{CBO} V	V_{CEO} V	Max. Cont. I_C mA	Max. I_{CM} A	Max. $V_{CE(sat)}$ at V	I_C mA	I_B mA	h_{FE} Min.	Max.	at I_C mA	Min. f_T at MHz	I_C mA	P_{tot} at T_{amb} =25°C mW	Complement
NPN														
FXT657SM	300	300	500	1	0.5	100	10	50	–	100	30	10	1000	FXT757SM
FXT655SM	150	150	1000	2	0.5	1000	200	50	–	500	30	10	1000	FXT755SM
FXT653SM	120	100	2000	6	0.3	1000	100	100	300	500	140	100	1000	FXT753SM
FXT651SM	80	60	2000	6	0.3	1000	100	100	300	500	140	100	1000	FXT751SM
FXT649SM	35	25	2000	6	0.3	1000	100	100	300	1000	150	100	1000	FXT749SM
PNP														
FXT757SM	300	300	500	1	0.5	100	10	50	–	100	30	10	1000	FXT657SM
FXT755SM	150	150	1000	2	0.5	1000	200	50	–	500	30	10	1000	FXT655SM
FXT753SM	120	100	2000	6	0.3	1000	100	100	300	500	100	100	1000	FXT653SM
FXT751SM	80	60	2000	6	0.3	1000	100	100	300	500	100	100	1000	FXT651SM
FXT749SM	35	25	2000	6	0.3	1000	100	100	300	1000	100	100	1000	FXT649SM

Centre Collector E-line SM RF Transistors

Type	V_{CBO} V	V_{CEO} V	Max. Cont. I_C mA	Max. $V_{CE(sat)}$ at V	I_C mA	I_B mA	h_{FE} at Min.	Max.	I_C mA	P_{out} at mW	f MHz
NPN											
FXT3866SM	55	30	400	1.0	100	20	15	200	50	700	400

3 CENTRE COLLECTOR E-LINE 'SM'

Centre Collector E-line SM NPN Darlingtons

Type	V_{CBO} V	V_{CEO} V	Max. Cont. I_C mA	Max. $V_{CE(sat)}$ at V	I_C mA	I_B mA	h_{FE} Min.	Max.	at I_C mA	Max. I_{CBO} at nA	V_{CB} V	P_{tot} at T_{amb} =25°C mW
FXT601BSM	180	160	1000	1.2	1000	10	2k	100K	500	100	160	1000
FXT605SM	140	120	1000	1.5	1000	1	2k	100k	1000	100	120	1000
FXT603SM	100	80	1000	1.0	1000	1	2k	100k	1000	100	80	1000
FXT38CSM	80	60	1000	1.25	800	8	10k	—	500	100	60	1000

Centre Collector E-line SM High Voltage Transistors

Type	V_{CBO} V	V_{CEO} V	Max. I_C mA	Max. $V_{CE(sat)}$ at V	I_C mA	I_B mA	h_{FE} Min.	Max.	at I_C mA	Max. I_{CBO} at μA	V_{CB} V	P_{tot} at T_{amb} =25°C mW	Complement
NPN													
FXTA42SM	300	300	500	0.5	20	2.0	40	—	10	0.10	200	680	FXTA92SM
PNP													
FXTA92SM	300	300	500	0.5	20	2.0	40	—	10	0.25	200	680	FXTA42SM

Centre Collector E-line SM Switching Transistors

Type	V_{CEO} V	Max. I_C mA	Max. $V_{CE(sat)}$ at V	I_C mA	I_B mA	h_{FE} Min.	Max.	at I_C mA	Min. F_T at MHz	I_C mA	Max. switching times at t_{on} ns	t_{off} ns	I_C mA	Complement
NPN														
FXT2222ASM	40	800	1.0	500	50	100	300	150	300	20	35	285	150	FXT2907ASM
FXT3904SM	40	200	0.2	10	1	100	300	10	300	10	70	250	10	FXT3906SM
FXT2222SM	30	800	1.6	500	50	100	300	150	250	20	35	285	150	FXT2907SM
PNP														
FXT2907ASM	60	600	1.6	500	50	100	300	150	200	50	50	110	150	FXT2222ASM
FXT3906SM	40	200	0.25	10	1	100	300	10	250	10	70	300	10	FXT3904SM
FXT2907SM	40	600	1.6	500	50	100	300	150	200	15	50	110	150	FXT2222SM

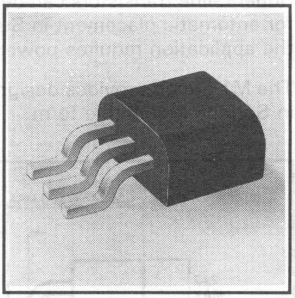
Centre Collector E-line SM Mosfets

Part Number	BV_{DSS} V	I_D mA	I_{DM} A	$V_{GS(th)}$ V Min.	Max.	at I_D mA	$R_{DS(on)}$ Ω Max.	at I_D mA	V_{GS} V	P_D W
N Channel										
ZVN4206C	60	600	8	1.3	3	1	2	1000	10	0.7
P Channel										
ZVP2106C	60	280	4	1.5	3.5	1	5	500	10	0.7

4 CENTRE BASE E-LINE 'M1'

The package that offers you more **POWER** and **PERFORMANCE** to meet your Surface Mount Requirements.

The range of E-Line M1 products has been specially selected to meet current and future design requirements



POWER

The improved chip construction, together with void free die attach and silicone encapsulant has given a device with a true 1W dissipation at 25°C, this allows a practical power dissipation of up to 1.5W when the collector lead is soldered to an equivalent of 1 square inch of copper.

PERFORMANCE

As a direct result of special design features, Super E-Line transistors out perform similar types of plastic transistors. In addition to the wide range of industry types Zetex has produced 3 ranges that fully exploit the unique features of E-Line.

Super E-Line ZTX650 and ZTX750 series

The ultimate performance in E-Line, featuring:

- Peak Current=6 amps
- Continuous current (I_C)=2 amps
- Low saturation voltage
- 1.5 watt practical power dissipation
- 1 watt dissipation at T_{amb}=25°C
- Voltages up to 300 volts (V_{CEO})
- Fast switching
- Excellent gain linearity

Super E-Line Darlington ZTX600 series

- 1A continuous current
- V_{CEO} up to 160V
- Guaranteed h_{FE} specification up to 1A
- 1.5 watt practical power dissipation

Medium power E-Line, ZTX450/ZTX550 series

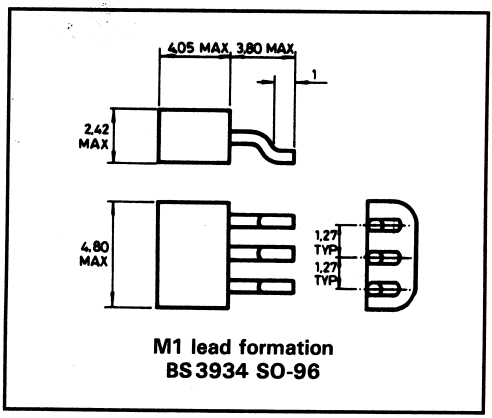
- Collector current (I_C)=1 amp
- Peak current=2 amp
- h_{FE} specified up to 1 amp
- P_{tot}=1 watt at T_{amb}=25°C
- Voltages up to 300 volts (V_{CEO})

CENTRE BASE E-LINE 'M1' 4

E-LINE "M1" IN TAPE FOR SURFACE MOUNTING

Super E-line transistors can be supplied with M1 lead form in 16mm embossed carrier tape suitable for automatic placement in Surface Mount Applications. The E-line M1 is particularly uesful when the application requires power dissipation in excess of that obtainable with SOT-23.

The M1 option provides designers with the wide choice of Zetex E-line and Super E-line transistors in Surface Mountable form.

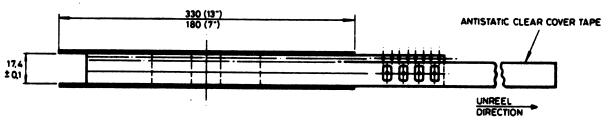


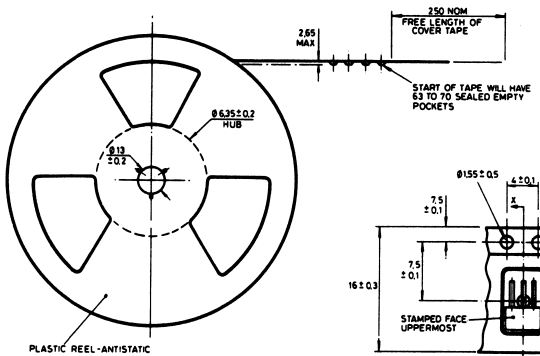
M1 lead formation
BS3934 SO-96

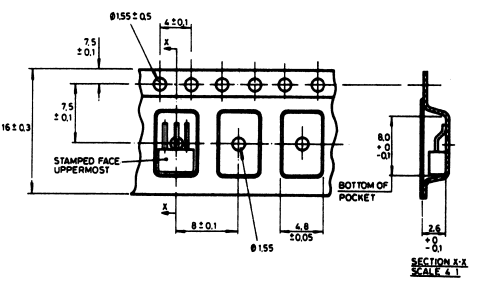
TAPE FEATURES

- Conforms to EIA 481. REV A.
- Start of tape will have 63 to 70 sealed empty pockets.
- End of tape on reel hub will have 26 min. sealed empty pockets.
- 7" reel to hold 500 components.
- 13" reel to hold 3000 components.
- Peel off strength of cover tape is 0.4 ± 0.3 newtons measured at 175° -180° with respect to the component carrier along the longitudinal axis of the carrier tape. The peel-off speed shall be 120 ± 5mm/min.
- Semi-conductive carrier tape resistivity less than $10^7\Omega/\square$.
- Ordering information:
  e.g. ZTX751M1TA 7" Reel 500/Reel.
  e.g. ZTX751M1TC 13" Reel 3000/Reel.

TAPE SPECIFICATION







4 CENTRE BASE E-LINE 'M1'

E-LINE "M1" SPECIFICATIONS (BIPOLAR)

Super E-line M1 Transistors

Type	V_{CBO} V	V_{CEO} V	Max. Cont. I_C mA	Max. I_{CM} A	Max. $V_{CE(sat)}$ at V	at I_C mA	at I_B mA	h_{FE} Min.	h_{FE} Max.	at I_C mA	Min. f_T MHz	at I_C mA	P_{tot} at T_{amb} =25°C mW	Complement
NPN														
ZTX657M1	300	300	500	1	0.5	100	10	50	–	100	30	10	1000	ZTX757M1
ZTX655M1	150	150	1000	2	0.5	1000	200	50	–	500	30	10	1000	ZTX755M1
ZTX653M1	120	100	2000	6	0.3	1000	100	100	300	500	140	100	1000	ZTX753M1
ZTX651M1	80	60	2000	6	0.3	1000	100	100	300	500	140	100	1000	ZTX751M1
ZTX649M1	35	25	2000	6	0.3	1000	100	100	300	1000	150	100	1000	ZTX749M1
PNP														
ZTX757M1	300	300	500	1	0.5	100	10	50	–	100	30	10	1000	ZTX657M1
ZTX755M1	150	150	1000	2	0.5	1000	200	50	–	500	30	10	1000	ZTX655M1
ZTX753M1	120	100	2000	6	0.3	1000	100	100	300	500	100	100	1000	ZTX653M1
ZTX751M1	80	60	2000	6	0.3	1000	100	100	300	500	100	100	1000	ZTX651M1
ZTX749M1	35	25	2000	6	0.3	1000	100	100	300	1000	100	100	1000	ZTX649M1

Medium Power E-line M1 Transistors

Type	V_{CBO} V	V_{CEO} V	Max. Cont. I_C mA	Max. $V_{CE(sat)}$ at V	at I_C mA	at I_B mA	h_{FE} Min.	h_{FE} Max.	at I_C mA	Min. f_T MHz	at I_C mA	P_{tot} at T_{amb} =25°C mW	Complement
NPN													
ZTX455M1	160	140	1000	0.7	150	15	100	300	150	100	50	1000	ZTX555M1
ZTX453M1	120	100	1000	0.7	150	15	40	200	150	150	50	1000	ZTX553M1
ZTX451M1	80	60	1000	0.35	150	15	50	150	150	150	50	1000	ZTX551M1
ZTX450M1	60	45	1000	0.25	150	15	100	300	150	50	50	1000	ZTX550M1
ZTX449M1	50	30	1000	0.5	1000	100	100	300	500	150	50	1000	ZTX549M1
PNP													
ZTX557M1	300	300	500	0.3	50	5	50	300	50	75	50	1000	–
ZTX555M1	160	150	1000	0.3	100	10	50	300	300	100	50	1000	ZTX455M1
ZTX553M1	120	100	1000	0.7	150	15	40	200	150	150	50	1000	ZTX453M1
ZTX551M1	80	60	1000	0.35	150	15	50	150	150	150	50	1000	ZTX451M1
ZTX550M1	60	45	1000	0.25	150	15	100	300	150	150	50	1000	ZTX450M1
ZTX549M1	35	25	1000	0.5	1000	100	100	300	1000	100	100	1000	ZTX449M1

CENTRE BASE E-LINE 'M1' 4

NPN Super E-line M1 Darlingtons

Type	V_{CBO} V	V_{CEO} V	Max. Cont. I_C mA	Max. $V_{CE(sat)}$ at V	I_C mA	I_B mA	h_{FE} Min.	h_{FE} Max.	h_{FE} at I_C mA	Max. I_{CBO} at nA	V_{CB} V	P_{tot} at T_{amb} =25°C mW
ZTX601AM1	180	160	1000	1.1	500	5	2k	20k	500	10	160	1000
ZTX601BM1	180	160	1000	1.1	500	5	20k	100k	500	10	160	1000
ZTX605M1	140	120	1000	1.5	1000	1	2k	100k	1000	100	120	1000
ZTX603M1	100	80	1000	1.0	1000	1	2k	100k	1000	100	80	1000

High Voltage E-line M1 Transistors

Type	V_{CBO} V	V_{CEO} V	Max. I_C mA	Max. $V_{CE(sat)}$ at V	I_C mA	I_B mA	h_{FE} Min.	h_{FE} Max.	h_{FE} at I_C mA	Max. I_{CBO} at μA	V_{CB} V	P_{tot} at T_{amb} =25°C mW	Complement
NPN													
MPSA42M1	300	300	500	0.5	20	2.0	40	—	10	0.10	200	680	MPSA92M1
PNP													
MPSA92M1	300	300	500	0.5	20	2.0	40	—	10	0.25	200	680	MPSA42M1

E-LINE M1 SPECIFICATIONS (MOSFETs)

'N' Channel Small Signal Mosfets

Part Number	BV_{DSS} V	I_D mA	I_{DM} A	$V_{GS(th)}$ V Min.	$V_{GS(th)}$ Max.	$V_{GS(th)}$ at I_D mA	$R_{DS(on)}$ Ω Max.	$R_{DS(on)}$ at I_D mA	V_{GS} V	P_D W
ZVN0545AM1	450	90	0.6	1	3	1	50	100	10	0.7
ZVN2535AM1	350	90	1	1	3	1	35	100	10	0.7
BS107PM1	200	120	2	—	—	—	23	25	2.6	0.5
ZVN2120AM1	200	180	2	1	3	1	10	250	10	0.7
ZVN2110AM1	100	320	6	0.8	2.4	1	4	1000	10	0.7
ZVN4206AM1	60	600	8	1.3	3	1	1.5	500	5	0.7
ZVN2106AM1	60	450	8	0.8	2.4	1	2	1000	10	0.7

4 CENTRE BASE E-LINE 'M1'

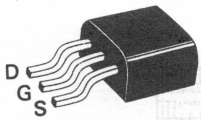
'P' Channel Small Signal MOSFETs

Part Number	BV_{DSS}	I_D	I_{DM}	$V_{GS(th)}$		at I_D	$R_{DS(on)}$	at I_D	V_{GS}	P_D
	V	mA	A	V Min.	Max.	mA	Ω Max.	mA	V	W
ZVP0545AM1	−450	−45	−0.4	−1.5	−4.5	−1	150	−50	−10	0.7
ZVP0535AM1	−350	−50	−0.48	−1.5	−4.5	−1	100	−50	−10	0.7
ZVP2120AM1	−200	−120	−1.2	−1.5	−3.5	−1	25	−150	−10	0.7
ZVP2110AM1	−100	−230	−3	−1.5	−3.5	−1	8	−375	−10	0.7
ZVP2106AM1	−60	−280	−4	−1.5	−3.5	−1	5	−500	−10	0.7

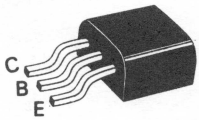
Low Threshold N-Channel MOSFETs

Part Number	BV_{DSS}	I_D	I_{DM}	$V_{GS(th)}$		at I_D	$R_{DS(on)}$	at I_D	V_{GS}	P_D
	V	mA	A	V Min.	Max.	mA	Ω Max.	mA	V	W
ZVNL535AM1	350	90	0.8	0.5	1.5	1	40	50	3	0.7
ZVNL120AM1	200	180	2	0.5	1.5	1	10	125	3	0.7

Pin Connections



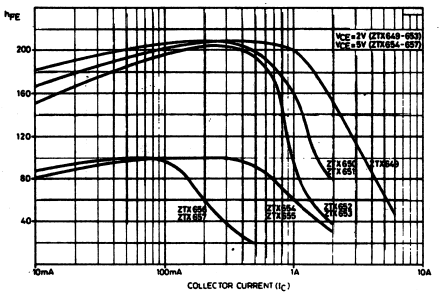
E-line with M1 lead form
MOSFETs



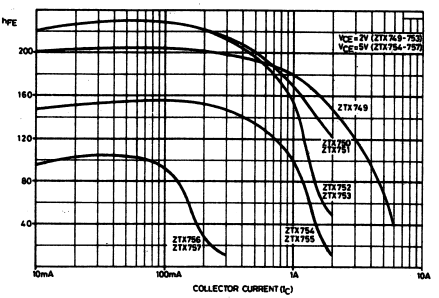
E-line with M1 lead form
BIPOLAR

TYPICAL CHARACTERISTICS

ZTX650 Series

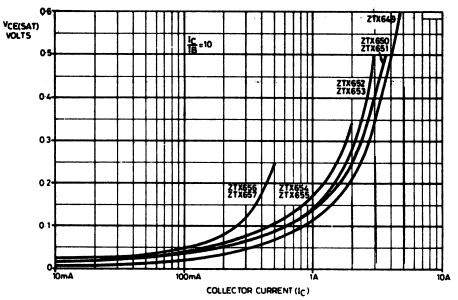


ZTX750 Series

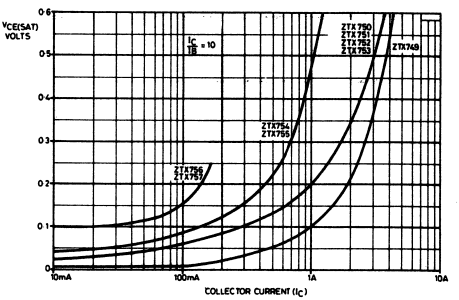


Typical static forward current transfer ratios plotted against collector current

ZTX650 Series

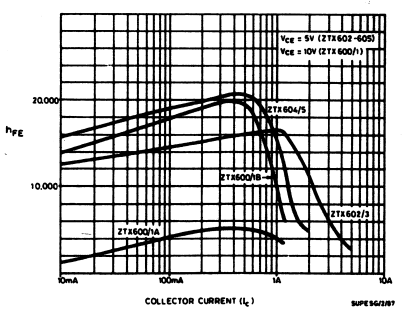


ZTX750 Series



Typical collector-emitter saturation voltages plotted against collector current

ZTX600 Series



Typical static forward current transfer ratios plotted against collector current

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